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EXPLORATION OF THE FRANKINCENSE COUNTRY, SOUTHERN ARABIA.*

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In revisiting the south-east of Arabia this winter, our hopes were to get from Muskat to the seat of our former work in the Hadramut, and to fill up the large vacuum in the map which this country offers. Experience has now taught us that this is impracticable, but that Arabia must be done piecemeal, and then patched together as it were; and, indeed, this is the most profitable way of doing any country, for the traveller on a great through journey generally loses the most interesting details. Probably no country in the habitable world is at present so little known as Arabia. Arab fanaticism, waterless wastes, piracy and brigandage, have all combined to exclude Europeans, and now that we know so much of the history of Greece, Egypt, Palestine, and other Oriental countries from monumental records, Arabia is about the only place left that will afford us new and startling discoveries in the study of primitive mankind.

Taking South Arabia from the east, we may rapidly enumerate the work that has been done. In Oman we have the journeys of Palgrave, Wellsted, and Colonel Miles; along the coast-line a few people have landed here and there, notably Dr. Carter and Colonel Miles, who both visited the coast of Dhofar, but no one has gone inland as far as the hills. Herr Hirsch and we ourselves penetrated into the Hadramut last year. Mr. Tate, Colonel Wahab, and Mr. Harrington have made dives into Yemen and the Yafi country, and, of course, around Aden the country is now pretty well known. Dr. Glaser has made some interesting archæological excursions to Sana, Marib, and other parts of northern

* Paper read at the Royal Geographical Society, June 6, 1895. Map, p. 204.

Yemen, Professor Schweinfurth and a few others have also visited Yemen, and Mr. Walter Harris also has made a journey from Aden to Sana, but with these exceptions the rest of South Arabia remains to be done. This evening I propose to describe the portion we have reclaimed this winter from the unknown, and relate our journeyings to and from Dhofar.

We reached Muskat on December 6 last, and there, with the kind assistance of Major Hayes Sadler, prepared to make our plans. We learnt that Oman proper might easily be surveyed at a time when the bellicose tribes in the interior are in a state of comparative tranquillity; to the west of Oman proper, there are several tribes of independent and hostile character, only nominally under the sway of the Sultan of Oman. Of these I may mention the Jenefa tribe, noted for slave-

IN MUSKAT HARBOUR.

trading and looting shipwrecked vessels; they are naturally much opposed to the visits of Europeans, lest their sources of livelihood should be imperilled, but if the traveller can secure his *kafeer*, or paid escort, from these chiefs, there is every likelihood that he would pass safely through their territories. West of the Jenefa tribe stretches the vast desert of Oman, which connects the arid wastes of Central Arabia directly with the Indian Ocean, and the crossing of which entails hardships which even the Arabs themselves are loath to encounter.

The most interesting feature in Oman is the Jebel Akhdar, or Green Mountain, which, with its ramifications, occupies the whole of the central district of this country, and rises to a height of over 8000 feet, and in the winter-time is very cold, and subject, we were told, to falls of snow. At the foot of this mountain is Nezweh, the old capital of Oman, and we heard reports concerning the grapes which grow there and the wine they make, and that it was the original home of the muscatel grape. We then proposed to pass through the Jenefa tribe to Ghubbet el Hashish on the west, and entirely abandon the desert

route as impracticable for Europeans. To arrange for this journey, the Sultan of Muskat and Major Sadler took infinite trouble; camels were hired, and a horse for Mrs. Bent, and the sheikhs of the various tribes through which we should pass were summoned to escort us. Owing, however, to the illness of some of our party, we were at the last moment obliged to leave the expedition for another season, and, as events proved, it was fortunate we did so, for the insurrection broke out almost immediately afterwards, and in all probability we should not have returned alive to relate our experiences.

Before entering upon a description of the Dhofar district, which formed the principal part of our winter's work in Arabia, a few words may not be amiss on the present condition of Oman, as it has lately been the scene of considerable local agitation. Muskat, the capital and seat of government, has many points about it which remind one of Aden. It has a good harbour, and is surrounded by arid volcanic mountains. It bears the same relation to the Persian Gulf that Aden does to the Red Sea, and it is now practically British as far as the environments of the town are concerned, and the Sultan occupies much the same position as the native independent princes do in India. If it were not for British protection, and the presence of our gunboat in the harbour, Sultan Feysul, the present ruler, would have long ago succumbed to the attacks of the chiefs from the interior, and the ambitious projects of his brother Mohammed. Though on paper the territory of Oman is exceedingly large, extending to the north as far as the Turkish limits beyond Bereymi, and to the west beyond the confines of the great desert, including Dhofar, a distance of over 700 miles, nevertheless the authority of the present Sultan is almost entirely confined to the two towns of Muskat and Mattra, and the small strips of fertility immediately contiguous to these places. His great-grandfather, Sultan Seyid Said, was a man of considerable power, but on his death Zanzibar was separated from Muskat, and Sultan Toweyni's power was much circumscribed by the ambitions of his nephew Tourki, who ultimately succeeded in getting his uncle assassinated, and in ascending the throne under British protection; his son Feysul now reigns in continual dread of the machinations of his immediate relations. He and his half-brother Mohammed never meet without an escort to protect them from each other, and under this state of affairs the power and audacity of the Bedouin chiefs outside Muskat have increased to an alarming extent, and this has been the cause of the recent disturbances.

The present dynasty has been on the throne since 1741, when the Said family rose from obscurity, and the founder of the dynasty was elected Imam by popular acclamation; he shook off the Persian yoke, and established Oman as a power in the East. His son, Said bin Ahmed, was the last of the elected Imams. The Imam, as head of the Church and army in Oman, had to take an oath to fight against all

infidels, but the next heir protested that this position was too expensive to maintain, so the Imamate, or spiritual lordship of Oman, has been in abeyance ever since. The result of this course of action has been a great laxity of religious opinion in Oman, fostered also by their natural antagonism to their fanatical neighbours, the Wahabi, who occupied the country and oppressed the inhabitants for a brief period at the commencement of this century. Nowhere in Arabia is Mohammedanism so lax as it is in Oman, offering a striking contrast to the bigotry of the people of the Hadramut, amongst whom our lot was thrown the previous winter.

The Omani form a third sect, as distinct from the Sonnites and Shiites, amongst whom the rest of the Muslim world is divided, and are known as the Ibadhiyah sect, or the followers of Abdullah bin Ibadh, who lived in the years 685–705 after the Hegira. The Sonnites recognize four successors of Mohammed as Imams—namely, Abubekr, Oman, Othman, and Ali. The Shiites reject all but Ali and his family, whereas the Ibadhiyites recognize none of these, but say that an Imam, if required, must be elected by the voice of the faithful. In Muskat one may enter the mosques without let or hindrance, and wretched neglected buildings they are, with only an apology for a minaret in one corner, about three feet high like an inverted bell. The chief buildings of Muskat are of Portuguese origin—namely, the two forts at either extremity of the town, and the ruined cathedral, which is now used as a stable for the Sultan's horses. Muskat has but few architectural attractions, a few carved balconies and doors, a few palaces, notably those of the Sultan and grand-vizier, and its aspect is one of squalor and dirt; few more unhealthy places could be found in the world. The narrow, dirty streets are the hotbed of disease, fostered by the moist heat to which it is subject. Just outside the walls by the fish-market is a malarious pond, into which the inhabitants throw their dead fish and other refuse, and the mephitic vapours from this, when the wind is from that quarter, spread fever broadcast through the town.

At the time when piracy was rife in the Persian Gulf Muskat was a great trade centre, but the overthrow of piracy and the introduction of steam has reduced Muskat to its normal condition, namely, that of a date-exporting harbour; nevertheless its strategical position and harbour will always ensure it a certain amount of trade and importance. The population of Muskat is strangely cosmopolitan for an Arab town. The merchants are chiefly Banyans from India and Persians; outside the town, in numerous encampments of reed huts, dwell colonies of Belouchis from the Mekran coast, African negroes from Zanzibar and Somaliland, and Bedouins from the mountains, by whom all the active labour of the town is carried on, whereas the Omani Arab is essentially lazy, and does as little for his livelihood as he can. Mattra, the commercial centre, from which all the roads to the interior start, is about

3 miles from Muskat round a headland; the journey thither is chiefly performed by water, the camel-track taking a long round through the mountains to get there. There is another road used in rough weather, partly by water, and then across a pass at the back of the headland. The scenery around Muskat is particularly fantastic and weird, but absolutely arid and unproductive, except where a few gardens are maintained by irrigation. The fishing village of Sadad is built on an inlet of the sea 4 miles south of Muskat, and the view over this, with its palm gardens belonging to Said Yusuf, and its fantastic background of tossed and tumbled volcanic peaks, intermingled with inlets of the sea, is one of the most striking I have ever seen. The coast-line, too, is very fine, with its beetling cliffs of black and green tufa rocks, the home of countless sea-birds. In one of the retired bays near Muskat, approachable only by sea, is the European cemetery, in which secluded retirement lie buried many men from the British gunboats, and the missionary

SADAD, NEAR MUSKAT.

Bishop French, who is probably the only man who has ventured to make an attack on the religion of Southern Arabia.

Dhofar, the ancient frankincense country, at which point we elected to commence our winter's campaign, is 640 miles by sea from Muskat; this distance we were prepared to traverse in a boat lent us by the Sultan, called a *bateel*, rather smaller than a dhow, when luckily one of the Turkish pilgrim steamers on its way to Jeddah put into Muskat, and the captain consented to drop us for a consideration at Mirbat, the first point of Dhofar, where the desert ends. Thus we were saved an uncomfortable sail of doubtful duration along an inhospitable coast, where the inhabitants are few, and celebrated for their marauding tendency.

Dhofar is nominally under the Sultan of Muskat. I may here emphatically state that the southern coast of Arabia has absolutely nothing to do with Turkey, and from Muskat to Aden there is not a single tribe paying tribute or having any communication with the Ottoman Porte.

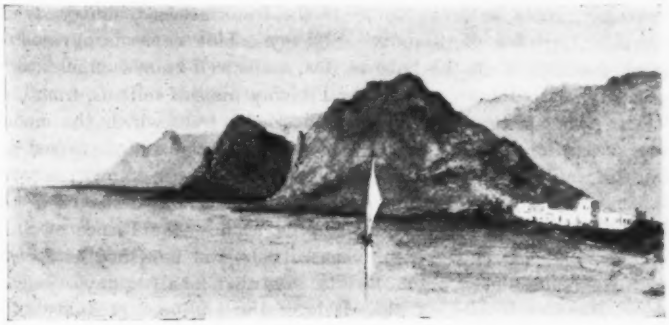
Eighteen years ago the inhabitants of Dhofar were in such a state of internal turmoil, and in such dread of the Bedouins of the Gara tribe, that they applied to Sultan Turki for a ruler. He sent them Wali Suleiman, a man of remarkable strength of character and determination, who has gained for himself a great reputation for bravery amongst the neighbouring Bedouin tribe, who all respect him and his authority. Suleiman was the son of a slave of Sultan Toweyni, and a most intimate friend and adherent of Sultan Turki, whom he greatly assisted in coming to the throne of Oman. He had only a hundred Arab soldiers with him when he reached Dhofar, but his skill was such and his powers of organization so efficient, that he defeated the Bedouins in several encounters, and now he boasts that he has twelve thousand Bedouins devoted to him, and told us with pride that two years ago he had sent two thousand rupees as tribute to Muskat, last year he had only sent one thousand, and that this year he had sent none. His next step will probably be, when a favourable opportunity offers, to declare himself independent under British protection. For this reason he was exceedingly polite to us, entertained us in his castle by the coast at Al Hafa during our stay, and arranged with the greatest possible assiduity for our safety during our exploration of the interior.

Dhofar and the Gara mountains which encircle it form a quite abnormal feature in this otherwise arid coast. From Cape or Ras Risut on the west to Mirbat on the east we here find a long narrow stretch of flat alluvial soil at the foot of the mountains, very little raised above the level of the sea. This plain is never more than 9 miles wide, and at the eastern end, where the mountains come down nearer to the sea, it is reduced to an exceedingly narrow strip. Water is here very near the surface. Streams making their way to the sea are of constant occurrence; consequently the plain is very fertile, and capable of producing almost anything. Along the whole line are many groves of coconut palms. Tobacco, cotton, Indian corn, and various species of grain grow here in great abundance; in the gardens we find many of the products of India flourishing, namely, the plantain, the papya, mulberries, melons, chilis, brinjoles, and fruits and vegetables of various descriptions. In fact, Dhofar and the Gara mountains may be termed one large oasis by the sea, bounded on the north by the Nejd desert, on the east by the Oman desert, and the gradual tendency to the west is towards the arid hills and sand-choked valleys which we met in the Hadramut last year. As we shall presently see, the Gara mountains are full of water, forming itself here and there into small lakes. They are decked to their summits with rich vegetation, and this will account for the fertility of the plain of Dhofar, and the strange contrast it forms to the rest of the coast-line of Arabia.

The one drawback to the progress of this country is its harbourless condition. During the north-east monsoons dhows can find shelter at

Mirbat, and during the south-west monsoons at Risut, but the rest of the coast-line is provided with nothing but open roadsteads with a rough surf always rolling in from the Indian Ocean, and we had considerable difficulty in landing ourselves and our goods at Al Hafa in small hide-covered boats specially constructed for riding over this surf.

We traversed the whole of this plain between Capes Risut and Mirbat in various directions, and found thereon the sites of ruined towns of considerable extent in no less than seven different points, though at the two capes where now is the only anchorage there are no ruins to be seen, proving, as we afterwards verified for ourselves, that anchorage of a superior nature existed here in antiquity, and which has since become silted up, but which anciently must have afforded ample protection for the boats which came here in the frankincense trade. At Takha, as we shall presently see, there was a very extensive and deep harbour,



COAST SCENERY WEST OF DHOFAR.

running a considerable distance inland, which with a little outlay of capital could easily be restored.

After a close examination of these ruined sites, there can be no doubt that those at spots called now Al Balad and Robat, about 2 miles east of the Wali's residence, formed the ancient capital of this district. We visited them last Christmas Day, and were much struck with their extent. The chief ruins are by the sea, around an acropolis some 100 feet in height. This part of the town was encircled by a moat still full of water, and in the centre, still connected with the sea, but almost silted up, is a tiny harbour. The ground is covered with the remains of Mohammedan mosques, and still more ancient Sabæan temples, the architecture of which—namely, the square columns with flutings at the four corners, and the step-like capitals—at once connects them architecturally with the columns at Adulis on the Red Sea, those of Koloe and Aksum in Abyssinia, and those described by M. Arnaud at Mariaba in Yemen. In some cases these are elaborately decorated with intricate

patterns, one of which is formed by the old Sabæan letters ⊙ and X, which may possibly have some religious import. After seeing the ruins at Adulis and Koloe, the numerous temples or tombs with four isolated columns, no doubt can be entertained that the same people built them all. As at Adulis and Koloe, there is unfortunately an absence of epigraphy which would materially assist us, but the subsequent Mohammedan occupation and the conversion of the temples into mosques may account for this.

This town by the sea is connected by a series of ruins with another town 2 miles inland, now called Robat, where the ground for many acres is covered with ancient remains; big cisterns and water-courses are here cut in the rock, and standing columns of the same architectural features are seen in every direction.

With the aid of Sprenger's 'Alte geographie Arabiens,' the best guide-book the traveller can take into this country, there is no difficulty in identifying this ancient capital of the frankincense country as the Μαντεῖον Ἀρτέμιδος of Claudius Ptolemy. This name is obviously a Greek translation of the Sabæan for some well-known oracle which anciently existed here, not far, as Ptolemy himself tells us, from Cape Risout. This name eventually became Zufar, from which the modern name of Dhofar is derived. In A.D. 618 this town was destroyed and Mansura built, under which name the capital was known in early Mohammedan times. Various Arab geographers also assist us in this identification. Yakut, for example, tells us how the Prince of Zufar had the monopoly of the frankincense trade, and punished with death any infringement of it. Ibn Batuta says that "half a day's journey east of Mansura is Alahkaf, the abode of the Addites," probably referring to the site of the oracle and the last stronghold of the ancient cult.

Claudius Ptolemy is certainly very clear in his geography of this coast. East of the Hadramut is the promontory of Syagros (Ras Fartak), and east of Syagros, on the Sachalites Sinus, first is mentioned the city of Manteion Artemidos (Μαντεῖον Ἀρτέμιδος), and then Abyssapolis (Ἀβυσσάπολις). Between this last-mentioned town and Rasal Hadd (Cape Coradamus), a long distance then as now of desert coast, he gives us no name. Sprenger sums up the evidence by saying that the town of Zufar and the later Mansura must undoubtedly be the ruins of Al Balad. He also associates Abyssapolis with Mirbat, and the existing evidence, as we have seen, quite confirms this statement. Thus, having assured ourselves of the locality of the ancient capital of the frankincense country—for no other site along the plain has ruins which will at all compare in extent and appearance with those of Al Balad—we shall, as we proceed on our journey, find that other sites fall easily into their proper places, and an important verification of ancient geography and an old-world centre of commerce has been obtained.

Wali Suleiman gave us of the best he had to offer, and placed the

best rooms of his castle at our disposal. The residences of the Arabs in Dhofar will not compare with those of the Hadramut, which surprised us so much last year. Wali Suleiman constructed his own when he came to the country, equi-distant from a cluster of villages which contain the chief Arab population of the plain. It is strong and substantial, and stands in an isolated position close by the coast; a fine gateway leads into a long dark passage, lined on either side by stone benches, where the Wali's soldiers recline, and where sheikhs from the mountains are regaled with coffee out of a huge coffee-pot with a long bird-like beak when they come to visit him. This passage leads into a spacious courtyard with a well in it, near which dwells the white she-ass, Wali Suleiman's only steed, on which he pays his state visits to the various villages in his dominions. Also there are here kept a considerable number of state prisoners, Beduins convicted of rapine, and Mahris captured in war. They are all bound with iron fetters, and the worst characters are chained to blocks of wood. Every night these prisoners said their prayers in a corner, led by an imprisoned mollah, and bewailed their misdeeds into the small hours of the night. This fact alone attests to Wali Suleiman's power over his neighbours. We never saw such a sight as this amongst the Hadramut sultans.

Wali Suleiman's ordnance is not of a high order; his soldiers mostly fight with the antiquated matchlock guns, and a few rusty old cannons stand near the doorway; but these are sufficient to overawe the Beduins, who have but little in the way of firearms. Outside the castle there is a large enclosure or bazaar, where the frankincense trade is carried on, and there is also a long palm-thatched shed which serves as a sort of parliament-house, where the chiefs who visit the Wali sit during the day, and a fire is always burning there to provide these guests with coffee. Almost directly you leave the castle you step into cultivated land extending in every direction for miles, and dotted with coconut groves around the villages, the houses in which are plain but substantial, being mostly built of stones brought from the ruins. The mosques here, as in Oman, are most insignificant, and the inhabitants do not appear to be the least fanatical.

After a few days' delay at Al Hafa, under the hospitable roof of Wali Suleiman, our arrangements for an expedition into the interior were made. To secure our safety, the Wali had summoned seventeen sheikhs or heads of families of the Gara tribe, who own the mountainous district behind the plain up to the confines of the Nejd desert, and in accordance with his summons they all arrived, bringing with them their camels with which to convey our party and our luggage. The whole convoy was placed under the guidance of one sheikh, Sayel, an old grey-haired, wiry man, dressed in nothing but a loin-cloth, but the possessor of so great wealth in flocks and herds that all the others treated him with great respect, and termed him the sheikh of all the

Garas. He owns seventy camels, worth 500 rupees apiece, and cows, sheep, and goats innumerable.

We never had to deal with wilder men in our lives than those who constituted our escort; they wore long unkempt hair, tied down with a leather thong like a boot-lace. Each man carried his wooden shield called a *gohb*, so constructed with a knob that he could turn it round and use it as a stool to sit upon; his wooden spear pointed at both ends, called *ghatrif*, a weapon peculiar to the Gara tribe, which they hurl with wonderful precision; and his flat iron sword called *saif*. Very few also carried matchlock guns. We found these wild men in most respects friendly during our wanderings, but of most independent spirit. If we asked them to do anything for us, they would reply, "We are sheikhs, not slaves;" and when once away from the influence of Wali Suleiman, they paid no heed to the orders of the soldiers sent by him, and during the time we were with them we had the unpleasant feeling that we were entirely in their power. They would not march longer than they liked; they would only take us where they wished, and they were unpleasantly familiar; with difficulty we kept them out of our tents, and if we asked them not to sing at night and disturb our rest, they always set to work with greater vigour. They got hold of our Christian names, and were for ever using them, to our great annoyance. They affected indifference for money, and absolutely the only hold we had over them was medicine; they positively loved my medicine-chest, and during our journey consumed an incredible quantity of pills, quinine, and other dainties. At first they would chew the pills, with disastrous results, but we soon taught them to swallow them in the orthodox fashion. Every night we had a row of them wanting to be doctored, and with this feeble weapon we ruled. Certainly they did well by us on the whole, and eventually we were satisfied that they took us to see everything in their country, but at first we doubted them greatly. They would chat pleasantly with us as we went along, but were ready at the slightest provocation to fly into wild incoherent rages, and the information they gave us about the country was never twice the same. Altogether the Garas are different in character and physique to any natives I have met elsewhere; in type they are akin to the Hadramut Beduin, small, active, and with finely cut features, but they are much wilder and less accustomed to contact with civilization. They live chiefly in caves and under trees, only using reed huts when they come down to the plain to encamp with their flocks during the rains.

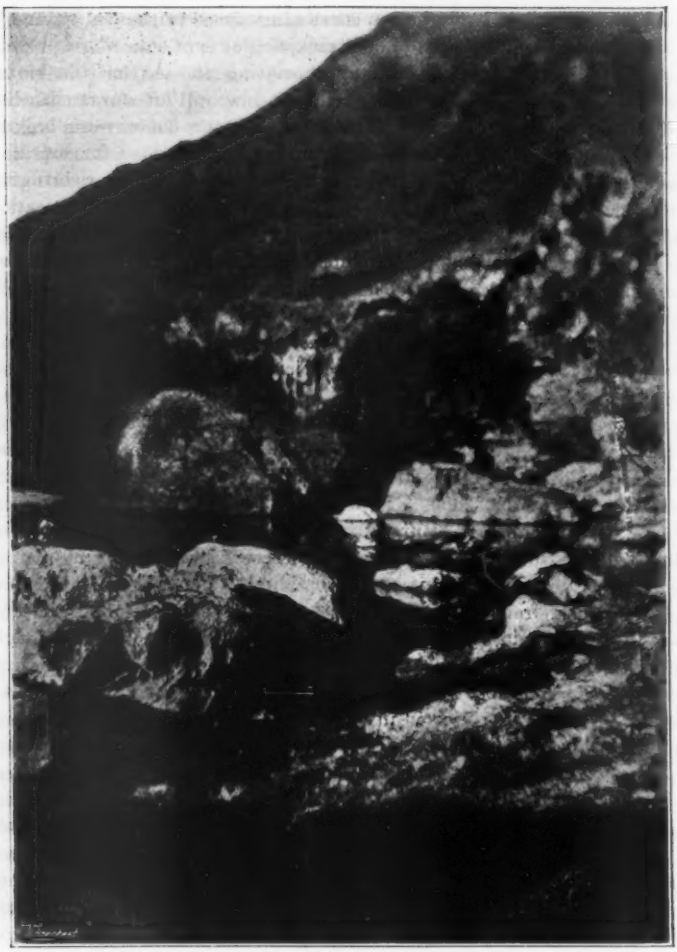
Not a whit less wild than their masters are the camels of the Gara; they danced about like antelopes, and made hideous noises when loaded, and we had the greatest difficulty in getting our goods fastened on to them. The Beduins were totally ignorant of camel-loading; they brought no ropes or thongs, a supply of which we were luckily able to obtain

from the Wali, and during the first days of our journey most of our baggage was thrown off and damaged, and it became quite a common sight to see a camel scampering away across the plain in terror, dragging its fallen load over rocks and through thorns. In the Hadramut we were surprised to see the camels eating fish; here in Dhofar we were still more surprised to find them consuming bones with avidity, and if they saw a bone on the side of the track, no power of ours would prevent them from stepping aside and appropriating it. As for the riding camels, they too were painfully wild, and we all in our turns had serious falls, and counted ourselves lucky that no bones were broken. The fertile highlands of the Gara country are celebrated for breeding camels, but they do not use them themselves except for bringing frankincense to the coast, as there is no trade route or communication with the interior through their country. These were our chief difficulties in travelling through the Gara country, but as we had no fear for our personal safety and the attacks of hostile tribes, we felt infinitely happier than in the Hadramut.

We left Al Hafa on December 30 last, and our first day's march took us close to Cape Risut, past several ancient ruined towns of minor importance. Near Cape Risut a large tract of country is covered with frankincense trees, with their bright green leaves like ash trees, their small green flowers, and their insignificant fruit. The frankincense, the old staple trade of this district, is still gathered in three places in the Gara mountains. The best is obtained at spots called Hoye and Haski, about four days' journey inland from Mirbat, where the Gara mountains slope down into the Nejd desert. The second in quality comes from near Cape Risut, and also a little further west, at a place called Chiseri, frankincense of a marketable quality is obtained, but that further west in the Mahri country is not collected now, being much inferior. The best quality they call *leban lakt*, and the second quality *leban resimi*, and about 9000 cwt. are exported yearly and sent to Bombay. It is only collected in the hot weather, before the rains begin, in the months of March, April, and May, for during the rains the tracks on the Gara mountains are impassable. They cut the stem, and after seven days return to collect the gum which has exuded; this they do three or four times a month, and in the cool weather, as the gum comes but slowly, they leave the trees alone. The trees belong to the various families of the Gara tribe; each tree is marked and known to its owner, and the product is sold wholesale to Banyan merchants, who come to Dhofar just before the monsoons to take it away.

One could not but feel interested in the existence still of this old-world trade on the very spot which was once so celebrated for it, when the odoriferous gum was much more prized for temple-worship and household consumption than it is now; and as we rode through the groves of this incense-bearing shrub we thought of the cunning old-

world legends of the dragons which were supposed to guard these trees, and of the death-giving odours which they were believed to exhale; for the old Sabæan frankincense merchants were jealous guardians of their treasures, and sought by awe-inspiring anecdotes to keep off competition.



LAKE IN THE WADI GHERSID, DHOFAR.

From Cape Risut we went inland to the base of the mountain range, and spent several days in visiting lovely little gorges, which run a short way into the mountains; but there is no approach by them to the

heights above, the wall of rock being here abrupt and impassable. They are lovely ideal little spots, with running streams and ferns and trees, bulrushes, reeds, and tropical vegetation. Beduin families live in the caves around, finding here ample fodder for their cattle. We originally understood that Sheikh Sayel was going to take us up to the mountains by a valley still further west, but for some reason, which we shall never know, he refused; some said the Mahri tribe was giving trouble in this direction, others that the road was too difficult for camels. At any rate, we had partially to retrace our steps, and following along the foot of the mountains, found ourselves encamped not so many miles away from Al Hafa.

The next day we entered the mountains by the Wadi Ghersid, the regular Gara track between the coast and the interior; the entrance to this gorge is about 9 miles from the Wali's castle, and on entering it a great surprise was in store for us. Instead of the sand-choked valleys of the Hadramut, arid except where irrigation is carried on with immense labour, we here were plunged into a valley covered with the richest tropical vegetation. Just above our camp, on the second day, water coming out of three holes in the mountain-side forms itself into a small and exquisitely beautiful lake, well stocked with duck and other water-birds, photographs of which we took; the encircling rocks are overhung with creepers, and covered with maidenhair and other ferns; huge fig-trees block up the valley, the lower branches of which are full of *débris*, showing how in the rainy season this gorge must be a raging torrent; limes, cactus, aloe, and mimosa form on all sides a delightful forest, whilst the mountains rising above the lake are clad almost to the summit with timber. Such a scene as this we never expected to witness in Arabia; it reminded us more of the rich valleys leading up to the tableland of Abyssinia, and never shall we forget the delightful evening spent by the lake of Ghersid. It is doubtless probable that a knowledge of such valleys as these gained for Arabia its ancient reputation for floral wealth. Passages in Theophrastus, Strabo, Athenæus, allude to this, and more especially to its wealth in aromatic plants. Aristotle calls Arabia εὐώδης, sweet-smelling, and Pliny more especially gives us a list of the trees and herbs grown in Arabia, and it is highly likely that the frankincense merchants who visited Dhofar in pursuit of their trade knew of these valleys, and not unnaturally brought home glowing accounts of their fertility, and gained for Arabia a reputation which has been thought to be exaggerated.

Next day we pursued our way up the gorge of Ghersid, climbing higher and higher, making our way through dense woods, often dangerous for the camel-riders, and obliging us frequently to dismount; sweet-scented white jessamine hung in garlands from the trees, and the air was fragrant with the odour of many flowers; above us towered grey rocks, and the hill-slopes were clad on both sides with trees.

We had one more camp in this lovely valley, almost at its head, where it is very narrow, and then on the following morning we commenced the ascent up a rugged path exceedingly difficult for the camels. The highest point of this range of mountains is not more than 3000 feet, and at our camp that night we registered 2600 feet. From above the aspect of this country is very curious. On the side towards the sea the mountains are cut by several deep gorges, similar to the Wadi Ghersid, full of vegetation, and all the hills around up to the summit are covered with grass and clusters of trees; as it was the dry season, this grass was converted into hay, which no one cared to harvest. Here and there in the brown expanse were isolated groups of fig-trees, of which we counted three varieties, and the thick foliage of these trees was full of birds; these groups of trees give a very park-like aspect to the country, and dotted over it we saw numerous herds of camels, goats, and cows grazing, which belonged to the Garas. We constantly came across their homesteads, which consisted of deep caves in the hillside, in which the families and the flocks live together in happy union; the calves and kids are penned in holes in the rocks, the milk is churned by shaking it in a skin attached to a tripod, and all their implements are of the rudest kind.*

We found the Gara women exceedingly shy and retiring—so different from the bold hussies in the Hadramut, who tormented us with staring into our tent; they fled, if we approached them, like timid gazelles. They have but poor jewelry—silver necklaces, armlets, and nose and toe rings; they love to join their eyebrows with antimony, and stick some black sticky stuff like cobbler's wax over their noses and foreheads; they are very small, and like Japanese; they do not cover their faces, and are very lightly clad in dark blue homespun cotton garments.

After proceeding along these highlands for two days, we decided to halt for two nights, nominally for a rest, as we had now been on the march for many consecutive days; but there came on the most frightful hurricane from the north, which blew steadily for two days and nights, and effectually prevented us from getting the rest we required. Our tents were with difficulty kept erect, and the cold was very trying. Our Beduins lay in an inert mass round wood fires, and our whole camp was for the time being thoroughly miserable.

From this point, however, we were able to take excellent observations around us, and form a clear idea of the configuration of the Gara range. The oasis-like nature of this range is here very marked; in all directions beyond it is desert. As it slopes down to the north it gradually becomes more and more arid, vegetation becomes more and more sparse, until it ends altogether in the yellow desert of Nejd, stretching as far as the eye could reach, and ending in the horizon in

* It is interesting to read in the 'Periplus,' § 32, a description of this coast, and of the high mountains behind, "where men dwell in holes."

a straight blue line as if it was the sea. Sheikh Sayel promised to take us across the Gara border into Nejd if we wished; but as it would have entailed a considerable delay and parley with the sheikhs of the Nejd Beduins, and as we could see from our present vantage ground that the country would afford us absolutely no objects of interest, we decided not to attempt this expedition.

On leaving our very exposed and nameless camping-ground, we pursued our course in a north-east direction, still passing through the same park-like scenery, through acres and acres of lovely hay worth nothing a ton. It is exceedingly slippery, and dangerous foothold for the camels; consequently numerous falls were the result, and much of our journey had to be done on foot.

On the second day we began again to descend down a hideous road, and a drop of about 1500 feet brought us to a remarkable cave just above the plain, and only about 10 or 12 miles from Al Hafa. This cave burrows far into the mountain-side, and is curiously hung with stalactites, and containing the deserted huts of a Beduin village, only inhabited during the rains. Immediately below this cave in the Wadi Nefas are the ruins of an extensive Sabæan town, in the centre of which is a natural hole 150 feet deep and about 50 in diameter; around this hole are the remains of walls, and the columns of a large entrance gate. We asked for information about this place, but all we could get in reply was that it was the well of the Addites, the name always associated with the ruins of the bygone race. In my opinion this spot is the site of the oracle mentioned by Ptolemy and others, from which the capital of Dhofar took its name. It much resembles the deep natural holes we found in Cilicia in Asia Minor, where the oracles of the Corycian and Olbian Zeus were situated. It is just below the great cave I have mentioned, and, as a remarkable natural phenomenon, it must have been looked upon with awe in ancient days, and it was a seat of worship, as the ruined walls and gateway prove; furthermore, it is just half a day's journey east of the city of Mansura or Zufar, where, Ibn Batuta somewhat contemptuously says, "is Al Akhaf, the abode of the Addites," and there is no other point on the plain of Dhofar where the oracle could satisfactorily be located from existing evidence. Sometime, perhaps, an enterprising archæologist may be able to open the ruins about here, and verify the identification from epigraphical evidence.

From this point we rode across the plain for about ten miles to the coast, at a place called Rizat, and were entertained for the night by Wali Suleiman, at a house he has built here, some 12 miles west of his permanent home at Al Hafa; but as his accommodation here is limited, we remained in our tents. Here he has utilized a running stream to fertilize several acres of ground, in which he grows tobacco, sugar-cane, jowari, and various other products; his garden is well stocked with

fruit and vegetables, and is delightfully shady, and we enjoyed a rest under a mulberry tree after our hot ride, and ate quantities of the small fruit. Wali Suleiman spends much of his time here, getting away from his troubles both domestic and political.

From Rizat to Takha is an uninteresting ride of 13 miles along the plain, past the mouths of several streams with plenty of water, clear but brackish, and with dense growth of mangrove down by the sea.

At Takha are extensive remains of an ancient town, which must have been second only in importance to the capital at Al Balad; similar columns, only without decoration, are standing here and there, marking the sites of tombs and temples, and we passed by several large stone sarcophagi and other remains. As the mountains come down here very near to the sea, the position is considerably more attractive, and the modern village is one of the largest of those scattered over the plain of Dhofar.

It at once occurred to us that this must be the site of the town which is alluded to by Claudius Ptolemy and Arrian as Ἀβυσσάπολις. Yakut tells us (iv. 481) "it is the harbour for the town Zufar, and is distant five parasangs from it. The harbour is good, and is often mentioned by traders, whereas the town Zufar has only a roadstead but no harbour." Ibm Khaldun, in his geographical account of the countries beyond Yemen, says, "Zufar was the seat of empire of the Tubbas, and Mirbat was situated on the seashore; both cities are now in ruins." Again, Bunbury, in his work on ancient geography, says, "The port of Moscha, which appears to have been a place of considerable trade, must probably have been situated in the district now known as Dhofar, a little to the west of the modern town Mirbat." Dr. Glaser, in his Arabian Geography, says, "If the Moscha of the Periplus must be sought for about 10 miles west of Mirbat, then I have no hesitation in saying that it must be identified with Abissa Polis and Tafa."

These accounts, if they at first sight offer a little discrepancy, can on inspection be easily reconciled. The ruins of Takha are exactly as Yakut says, 5 parasangs or 20 miles west of those of Zufar at Al Balad, and as there are none at the modern town of Mirbat, and only indifferent anchorage during the north-west monsoons, it would suggest itself that the Mirbat of antiquity was situated here.

On the following day this somewhat puzzling question was settled for us by finding the only thing wanted to identify the spot, namely, a commodious harbour. An hour's walk from our camp near Takha took us across a promontory where the estuary of a river forms quite a large lake, separated from the sea only by a narrow sand-belt over which the water flows at high tide. Around this lake are the ruins of several ancient buildings, and what is now a headland connected to the mainland by a neck of sand is surrounded by an ancient wall and fortification, and bears the appearance of once being an island protecting the

entrance to a harbour. The similarity to some of the ancient Greek harbours is here very striking, and the lake, when connected with the sea by a proper channel, as it must have been until quite a recent date, must have formed a most spacious and commodious harbour.

Here we had the one thing wanting to identify the site, namely, the harbour of which Yakut tells us, where the ships which came to Dhofar in the frankincense trade found anchorage. The Abyssapolis of Ptolemy, like Manteion Artemidos (Μαντεῖον Ἀρτέμιδος), is evidently the Greek equivalent for some Sabæan name, or merely called from the existence near here of a remarkable abyss which we shall presently visit. The name given us by Ibm Khaldun of Mirbat is still attached to the village and anchorage 12 miles to the west, where the modern dhows go, and the term "Moscha" or "Mocha," which Arrian here introduces, is one frequently occurring on the Arabian coast, and apparently means, as Dr. Glaser tells us, an inlet or harbour, and consequently we have no difficulty in deciding that the ruins and harbour near Takha are those of the ancient town and harbour known to the Greeks as Abyssapolis (Ἀβυσσάπολις), or Moscha, and to the natives as Mirbat.

We skirted along the lake, which is called by the natives Kho Rowri, for a mile or more as we rode inland from the coast, until it dwindled into a narrow stream, and then lost itself in the dry rocky bed of a torrent coming down from the valley we were about to enter. A ride of 4 or 5 miles brought us up to the higher range of mountains again and the opening of the valley, and after following this for another mile, we pitched our camp at the foot of one of the most stupendous natural phenomena we have ever seen. The valley leading down to the sea has been filled up in the course of ages by a calcareous deposit, collected on either side of an isolated hill in the middle of the valley, about 1000 feet in height. This deposit has taken the form of a perfectly straight and precipitous wall 550 feet in height and three-quarters of a mile long on the eastern side of the hill, and about a quarter of a mile long and 300 feet high on the western side.

Over these walls feathery waterfalls precipitate themselves something in the style of the Staubbach, adding perpetually to the chalky secretions of which these walls are constructed. During the rains the falls must be magnificent, but, as I have said before, it was the height of the dry season when we visited it.

The general appearance of these walls is white and whitish-grey, with long white stalactites hanging down in tumbled confusion; it is streaked here and there, where the water perpetually falls, with patches of green, and below it plantains 20 feet high, enormous castor-oil plants, daturas, and many other plants flourish, and the Beduins have utilized the stream before it loses itself in the rocky channel to make small gardens.

The rocky channel below is itself very curious, being a flat surface

about 50 yards across, of perfectly white calcareous rocks, and just below the wall where the water comes down there is an enormous amount of white calcareous deposit, quite soft and springy to walk upon.

The general aspect of these two walls is exceedingly striking from below, they are so sheer and straight; and it was curious to see the Beduins, who live above, like tiny dwarfs looking over the dizzy height in wonder at the first Europeans who had invaded their wonderful abode.

As we looked at this precipice, there seemed to be no doubt as to why Claudius Ptolemy had given the name of Ἀβυσσάπολις to the town on the coast. The merchants who came there for frankincense must have known of it quite well, and marvelled like we did at this great natural phenomenon in the mountains just behind the town. Similarly, another town in Arabia is called Abisamapolis (Ἀβίσαμαπόλις) by Ptolemy, which has a steep mountain behind it 4000 feet high, up which a road leads to Marib (Sprenger, § 96), and it is also clear that Greek names were given by foreign traders to the places they visited from local peculiarities; for example, the μαντεῖον Αρτεμιδος must have been the seat of the oracle of some female Sabæan goddess corresponding in attributes to Artemis. Be this as it may, the stupendous abyss stands there still as one of the world's wonders, constructed by nature on the same principle as the pink and white terraces in New Zealand, and the calcareous deposits of Yellowstone Park.

To thoroughly explore the vicinity of this wonderful spot, we stayed in our camp at the foot of the abyss for three nights.

On the first morning we set out early to climb the hill and see what is to be seen at the top of the abyss. A rough camel-track has been made to climb this hill, which has been partly swallowed up by the calcareous deposit, and forms a spur covered with thick vegetation, with strange peeps through the branches at the wall and the waterfalls on either side: from this path we got an excellent view and photo of the smaller abyss, which the natives call Merga, whereas the larger abyss and the water at the top of it is known as Dirbat, which looks as if it had some close connection with the name Mirbat which we have just alluded to. More water falls over the smaller abyss than over the larger one, and when we were there two considerable falls were precipitating themselves over it.

On reaching the top of the abysses, we found ourselves on a lovely grassy plain, as flat as a billiard-table, and grazed over by quantities of cows belonging to the Gara herdsmen. We walked along for about a mile under the grateful shade of large trees, and when we had rounded the jutting hill, we found ourselves by the side of a long, narrow lake, which feeds the several channels which fall over the abysses; and when the Beduins want to water this extensive meadow, they dam up these

channels, and thus have a natural source for irrigation provided for them even in the driest weather.

The banks of this lake are adorned with very fine timber, principally fig-trees and mimosa, amongst the branches of which a fine convolvulus with large pink flowers was creeping. The lake is full of bulrushes, and quantities of birds live on it—wild duck, herons, and waterhens; in some parts it is very deep, and it is divided into two parts connected by a narrow running stream; it is not broader in the dry season than a wide river, and in length it is about 2 miles, and the source which feeds

ABYSS OF DIRBAT, DHOFAR.

it comes out of the mountains behind, and can be traced up a narrow gorge for about two days' journey.

The Beduins have many superstitions connected with it, and, indeed, it is a most fairylike-looking spot; they affirm that jinnies live in the water, and that whoever wets his feet here is sure to have fever. Sheikh Sayel assured us he had actually seen the jinni, as also one which dwells in a cave hard by, where some Beduin herds have their farmstead. The mountains on either side are very curious, being honeycombed with caves and fissures, and in one place there is a large hole in one of the mountains through which daylight can easily be seen. The slopes of the hills on either side of the valley are covered with rich timber and vegetation, and the possibilities of this valley, if brought under proper cultivation, struck us as very great. Altogether, the abysses, with the lake and flat valley above it, struck us as quite the

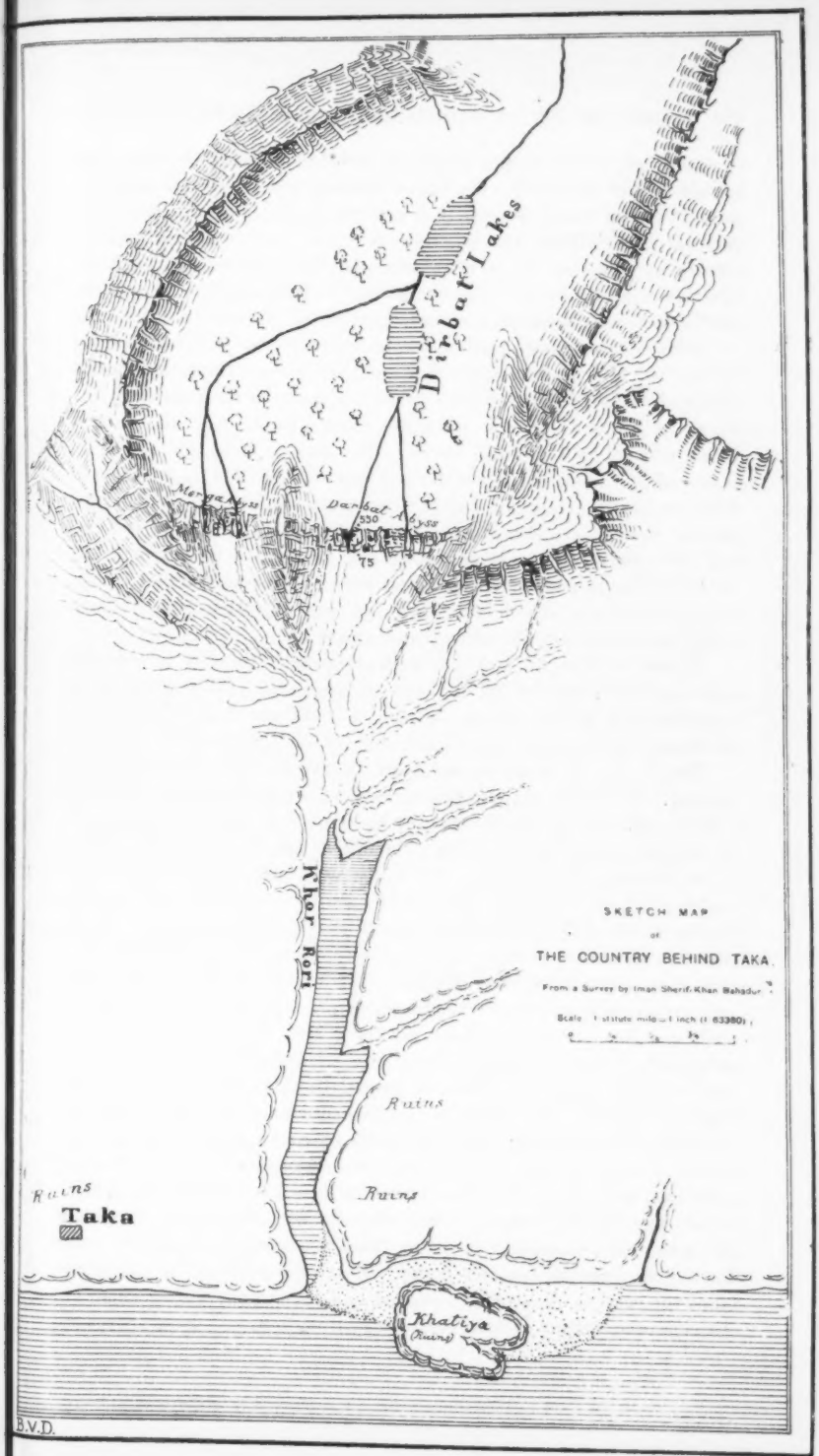
most weird and fascinating spot we had ever visited in any of our wanderings.

After going up to the head of the lake, we partook of some refreshments under a wide-spreading fig-tree by the side of the lake. We then went down to the end of the valley to peep over the abyss. The Beduins had been damming up the channels for irrigation, and we had to cross much swampy ground, and got our feet wet without catching the inevitable fever; and after pursuing our way for about a mile, we reached the edge of the large abyss and peeped over into the dizzy depth below. Needless to say the view is a most striking one, and the sun's rays made lovely rainbows in the feathery falls, and far below us our tents looked like tiny specks in the trees.

Every November a fair or gala is held up here by the side of the lake, to which all the Beduins of the Gara tribe come and make merry,

LAKE OF DIRBAT, ABOVE THE ABYSS.

and the fair of Dirbat is considered by them the great festival of the year. A round rock was shown us on which the chief magician sits to exorcise the jinni of the lake, and around him the people dance. There is doubtless some religious purport connected with all this, but, as I have said before, it is extremely difficult to get anything out of the Beduins about their religious opinions; like the Beduins of the Hadramut, they do not observe the prayers and ablutions inculcated by the Mohammedan creed, and the Arabs speak of them as heathen, but beyond this we could not find out much. Their language, too, is different from anything we had heard before. They can understand and converse in Arabic after a fashion, but when speaking amongst themselves none of our party, Arab or European, could make out anything they said, and from such simple words as we were able to learn—such, for example, as *ouft* for *wadi*, a valley, *shur* instead of *yom* for "day," and *kho* instead of *nahr* for a river—we were led to believe that they speak an entirely different language, and not a dialect as in the Hadramut.


Dirbat Lakes
Mongalkot
Dirbat
330
75
Khor Rori
Ruins
Ruins
Ruins
Taka
Khatiya
(Ruins)
SKETCH MAP
of
THE COUNTRY BEHIND TAKA.
From a Survey by Iman Sherif-Khan Bahadur.
Scale 1 statute mile = 1 inch (1 63360).
B.V.D.

Sprenger (§ 449) supposes that the tribal name Gara or Kara corresponds to the ancient Ascites whom Ptolemy places on this coast; but as the Ascites were essentially a seafaring race, and the Gara are a pastoral tribe of hill Beduin, the connection between them does not seem very obvious. It is more probable that they may correspond to the Carrei mentioned in the campaign of Aelius Gallus as a race of Southern Arabia, possessing, according to Pliny, the most fertile country.

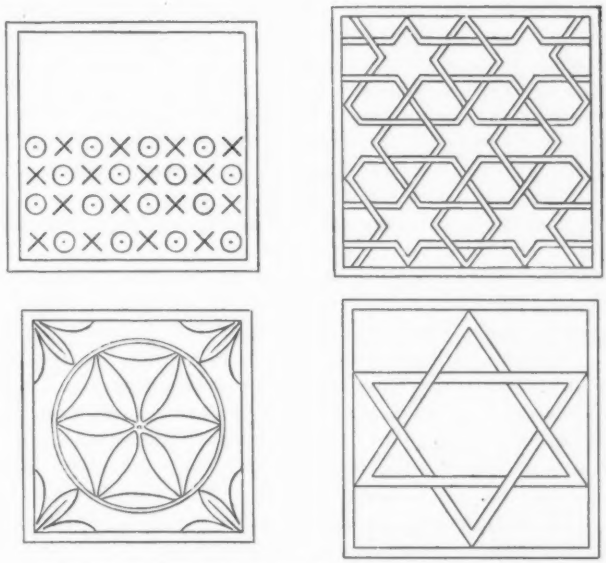
After another day spent in sketching, photography, and measurements, we felt that we had thoroughly explored the neighbourhood of the abyss, so we started back to Al Hafa, which we reached in three days, to prepare for our departure from Dhofar, and the interests which centred in this small district—the ancient sites, the abyss, and, above all, the surprising fertility of the valleys and mountains, the delicious health-giving air, and the immunity from actual danger which we had enjoyed—combined in making us feel that our sojourn in Dhofar had been one of the most enjoyable and productive of any expedition we had hitherto undertaken, and that we had discovered a real Paradise in the wilderness, which will be a rich prize for the civilized nation which is enterprising enough to appropriate it.

It was with regret and manifold misgivings that we now entered upon another phase of our Arabian journey, and faced a series of disappointments, which, had we foreseen, I think we should have tarried far longer under the favourable influence of Wali Suleiman.

He did all he could to assist us in the further progress of our journey. When we told him that our object was to go across the Mahra country by land to the Hadramut, he wrote and sent a messenger to the neighbouring Mahri Sultan of Jedid to ask his permission for an escort through his country; the reply was unfavourable, so we had nothing left to do but to hire a *bateel* and set sail along the coast for Kishìn, to the Sultan of which place I had a letter from the British political agent at Muskat. A long sea-journey in an Arab bateel is exceedingly uncomfortable. We had a cabin in the stern open all round, and with a sail in front to secure some privacy, and so low that we could not sit up in it, and for six days Mrs. Bent remained in her camp-bed without getting up, for the simple reason that there was nowhere else to go to. Then the smell of bilge-water was horrible. Every silver thing we had about us turned black, and our clothes will probably never recover from the sulphureous vapours to which they were exposed; the water in our butts was the home of cockroaches and scorpions, and our cooking was done in a square wooden box with ashes in it. For the first two days we had little wind, and made very slow progress, our compensation being that we passed slowly by most exquisitely beautiful coast scenery. From Cape Risut for about 100 miles the coast is exceedingly rugged and precipitous, rising sheer out of the sea to a height of 1000 feet. Vegetation here and there adorns the

only available spots where earth is to be found, and now and again appeared outcrops of the calcareous deposit, like waterfalls down the cliff—small replicas of the abyss which we had visited behind Takha.

We anchored for one night off Rakhiut, the most western fortress of Wali Suleiman, which he has erected to ward off the attacks of the hostile Mahri tribes; another night we were in slight alarm from some Mahri Beduins, who called to us from the shore. Our sailors told us they were trying to beguile us ashore with a view to plunder; consequently we turned a deaf ear to their cries, and anchored about 100 yards from the shore. As slave-traders and wreckers the Mahris have



PATTERNS ON FOUR SIDES OF THE CAPITAL OF A COLUMN, DHOFAR.

the worst possible reputation along this coast amongst the owners of Arab buggalows, dhows, and bateels, and no wise captain ever ventures to land about here if he can help it. At length the longed-for breeze arose, and carried us in two days past Ras Fartak to the harbour of Kishìn.

Between Jedid and Ras Fartak the land is low and recedes, and as we sailed along we decided that it was the mouth of some big valley from the interior, and after careful cross-examination of the Sultan of Kishìn and our sailors, we gathered that this was actually the mouth of the great Hadramut valley, which does not take an extraordinary bend as is given in our maps, but runs in almost a parallel straight line

to the sea from west to east, and the bend represents an entirely distinct valley, the Wadi Mosila, which comes out at Saihut.

At Kishìn I landed to interview the Mahri Sultan Salem, and see if he would conduct us up to the Hadramut valley; here again we met with a positive refusal. "No one goes up that way," he said; "it is full of robbers." The town or village of Kishìn is a truly wretched place, with a few houses and reed huts scattered about in a dreary waste of sand; very different from the fertile plain of Dhofar, and very like the environs of Sheher, the sea-coast city of the Hadramut. Sultan Salem is very old and decrepid, and he is one of the chief sheikhs of the Mahri tribes, the head of a gang of thieves. Of course, he was civil enough to me with my letter from Muskat, but I think his people were rather sorry to see so likely a prize depart unmolested. Sultan Salem is nominally the lord-paramount of the island of Socotra, but he does not trouble his island dependency much, and from what I could see I should say he and his tribe were fast succumbing to senile decay; he is the brother of the Sultan of Saihut, another robber-chief of the Mahri tribe, who is greatly averse to admitting Europeans into his dominions. The fact is, these tribes feel that if their present state once became the object of European inquiry, they would be no longer able to exist in their present condition.

After our futile attempts to penetrate into the Mahri country, there was nothing left for us but to start again in our boat for Sheher, and rely on the promises which Sultan Houssein Al Kaiti had given us last year of sending us under safe escort to the eastern portion of the Hadramut valley, which must contain much of interest, and has never yet been visited by Europeans. He undoubtedly would have done it for us last year, having made all the necessary arrangements, but the season was so advanced that it was impossible to undertake it, as we must have waited till Ramazan was over. This year, however, to our great disappointment, our reception at Sheher was cold and inhospitable; the Sultan refused to let us go out of his town, and quite negatived all his previous promises. So far as this year was concerned the further survey of the Hadramut had to be abandoned. Our plan was to go up the Wadi Mosila, which is said to contain many interesting sites of ancient towns, to cross over the tableland again east of the hostile Katiri tribe, visit the tomb of the Prophet Hud, the Mecca of this portion of Arabia, and the volcano of Bir Barhut, which has been described to us as a large hole in the mountain-side, out of which issue volumes of smoke; it is similarly described by the old Arab geographers such as Hamdani, Idrisi, and others, and is the place described in the Koran as the abode of infidel souls after death. This neighbourhood should be replete with natural and historical interest, and we fondly hope that, with adequate support from the Aden Government, we may be able to reach it another year.

In conclusion, I must add that Imam Sharif Khan Bahadur, who accompanied us last year in the Hadramut, was again kindly placed at our disposal by the Indian Government, and was as before exceedingly useful to us in our various difficulties. To him we owe the maps of the Hadramut and Dhofar districts, and I am sure his regrets were equal to our own at not being able to join these two important surveys of Southern Arabia, and thereby place before the world a consecutive map of this unknown region.

NOTE FROM KEW ON THE COLLECTION OF PLANTS.

"The botanical collection, although more numerous in species than that made in the Hadramut, comprising about 250 species as against 150 from the latter country, has less of a local character, and, as might have been expected, exhibits a larger proportion of species having an eastern extension. Apparently it contains no new generic type; but as the plants have not yet been thoroughly examined, some one of the obscure-looking things may prove to be such. Certain it is, however, that there is no very striking novelty of this rank, and the number of new species will not be very great. The most interesting feature in the collection is the presence of specimens of several plants of more than ordinary importance in relation to their products or distribution. Noteworthy among these are the wild cotton, *Gossypium Stocksii*, and excellent specimens of the frankincense, *Boswellia Carteri*. This species of cotton was previously only known from Sind; and the specimens of frankincense prove Carter to have been right about the species from this region, though the fragments Kew previously possessed were insufficient to place the fact beyond doubt. The present specimens are exactly like those collected by Playfair and Hildebrandt in Somaliland. *Balsamodendron Opobalsamum*, one of the myrrhs, is also in the collection. *Acridocarpus Orientalis*, a very conspicuous member of the Malpighiaceæ, was found at the foot of the Dhofar mountains. It is interesting, because it was originally collected by Aucher Eloy, but the locality was uncertain. He probably collected it in the Muskat district. *Gypsophila montana*, a wiry herb of the Caryophyllaceæ, is an illustration of that element of the flora common to Aden, Sokotra and Somaliland.

"W. B. H."

Before the reading of the paper, the Chairman, Admiral WHARTON (Vice-President), said: It requires no words from me to introduce to this Society Mr. Theodore Bent, who has so often delighted audiences here, and I hope he is going to do so again to-night. Mr. Bent has had many difficulties to contend with, and he has been disappointed in not being able to accomplish all he has wished, but I feel certain his paper will prove very interesting, and I will now call upon him to read it.

After the paper, Sir WILLIAM FLOWER said: I am asked to say a few words, but I am sorry to say that Mr. Bent has not given me the slightest opening to say anything about his paper. He has been to a most interesting country, and he has told us he has collected plants, and I congratulate Mr. Thiselton Dyer, of Kew, for having the opportunity of seeing something of the flora of the country. But he has not mentioned a single creature—except I think I heard him speak of a wild duck—in the animal kingdom, about which I can have anything to say. Of course it is impossible that a man can do everything, and such explorers as Mr. Bent must first go and open out these unknown countries, and naturalists will follow afterwards. I am sure that in a country so full of beautiful vegetation as this, there

must be a variety of interesting animals. In Mr. Bent's previous journey he had a collector of zoological specimens, and he brought back many of great interest; but I am afraid that the experience of taking the zoological collector was not on the whole, so far as the geographical results of the expedition were concerned, very satisfactory, and so Mr. Bent informed me, to my regret, before he went on this journey, that he should not impede himself with such a person again. Well, I suppose he was right, because, as I say, no man can do everything at once, and, although I have had no opportunity of saying anything in reference to my particular subject, I think I can say, as no one else has got up to do so, that we all here feel great satisfaction and pleasure at the safe return of Mr. and Mrs. Bent from this interesting journey. We all feel that they have done a very great work of geographical exploration, because they have brought before us features of the country which are entirely new to very many of us. I had no idea that behind the arid rock-bound coast, as it always seemed, of Southern Arabia could be found these beautiful green and watery vales, the photographs of which remind us at times of some parts of our own land. I therefore feel that Mr. Bent has done excellent work. Moreover, he and Mrs. Bent have performed this work under circumstances of considerable danger. They have happily surmounted all these dangers. And we hope this is not—I will not say the beginning, because they have begun already a long time ago—but we hope that this is only a stage of progress reached in a work which may go on for many years yet, and I am sure that geographical science, and with it the progress of humanity and civilization, will be very much forwarded by their exertions.

The CHAIRMAN: Mr. Bent has not taken us over a very large extent of country this time, but he has taken us to a very interesting one—to the home of the old frankincense trade, of which history scarcely knows the beginning. He is very much to be congratulated, I think, although he had difficulties that prevented him going in other directions where he wished to, that he found this country open; because the last account we had of it was, that you could not venture more than half a mile beyond the beach, and the inhabitants were always internecinely engaged in killing one another, and two men of different villages had to get an intermediary to allow them to talk to one another. Mr. Bent has happily come after the beneficent rule of Wali Suleiman, who has made his strong hand felt there, and who has opened the country up. I think there is nothing more interesting than going through a country with a history and endeavouring to recognize the old sites, and I think Mr. Bent has unearthed the harbour that must have existed in ancient days when the frankincense was more sought after than now, and when the trade was very much greater. Whether it could be made of any service now is another question. Mr. Bent seems to think it might be, and it it is very possible it may be so. I am sorry that on the maps we have here, Al Balad, the ruins of which he has discovered, is not marked. It is to the westward of Al Hafa, and I think there is no doubt that that was the old centre of civilization in this region. I think, ladies and gentlemen, you will all join with me in heartily thanking Mr. Bent for the very interesting information that he has given us in his paper.

BATHYMETRICAL SURVEY OF THE ENGLISH LAKES.*

By HUGH ROBERT MILL, D.Sc., F.R.S.E.

VIII. Wastwater.

The third and last lake of the western radiating system is the deepest of the whole district, and the wildest in its scenery. It lies appropriately at the base of the loftiest mountains in England, Scafell Pike and Scafell (see Map V.).

FIG. 10.—BIRD'S-EYE VIEW OF WASTWATER FROM STYEHEAD PASS, SHOWING SCREES ON THE LEFT, GENTLE SLOPE ON THE RIGHT.

(*Photograph by Mr. A. Pettitt, Keswick.*)

Wastwater has an area of 1·12 square miles, the same as Ennerdale Water, and as its total length is 3 miles, its average breadth is 0·37 mile, or 650 yards. The actual breadth varies from half a mile at the bay south of Nether Beck delta to quarter of a mile at the square-cut head, and

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the almost equally abrupt lower end. The drainage area tributary to the lake measures 18½ square miles, being rather more than seventeen times the extent of the water surface. The main tributary flows down the flat plain of lower Wasdale, and enters the head of the lake at the northern corner. The axis of the lake is slightly curved, but in the main runs south-west, following the outline of the left or south-eastern bank, which is in all parts steep, and along a great part of its length is flanked with the grandest screes in the Lake District (see Figs. 10, 11). For 1½ mile along the lower part of the lake the contour-line of 1500 feet of elevation

FIG. 11.—THE SCREES OF WASTWATER, FROM THE OPPOSITE SIDE OF THE LAKE.
(*Photograph by Mr. A. Pettitt, Keswick.*)

runs within 1500 feet of the margin of the lake, and at some points the average slope of the whole hillside equals 45°. No definite stream flows down these screes. The right or north-western side of the lake does not present so uniform a coast-line as is furnished by the screes; the hillside is not so steep. It is separated from the lake by a band of gently sloping ground, and halfway along the lake the hills fall back and the shores become flat at the lower end. The Over Beck, Nether Beck, and Countess Beck flow in from valleys in the hills, and the delta of each makes a small but clearly outlined promontory on the lake. The right shore is also fretted with several tiny headlands formed by little ledges

of rock sheltering small bays. There is one small rocky island close to the right shore, near the lower end of the lake.

According to the Ordnance Survey in December, 1864, the surface of Wastwater, when the water was high, was 204·4 feet, and when the water was low 199 feet, above sea-level. When we visited the lake on July 10 and 11, 1893, we found the bench-mark of 204·4 feet just 4·7 feet above the surface of the water, which may thus be taken as practically 200 feet above sea-level at the time of our soundings, so that the contour-line of sea-level would be the isobath of 200 feet (see Map V.).

During the two days of our work the weather was very bad, and the only available boat was ill-adapted for the purpose, but we succeeded in making 24 sections of a total length of 10½ miles, comprising 275 soundings. The closeness of the soundings averaged 26 to the mile, and 246 to the square mile. In fact, only Derwentwater, Haweswater, Bassenthwaite, and Coniston were more thoroughly sounded. The volume deduced from the soundings was 4,128,000,000 cubic feet, about equal to that of Coniston, and exceeded only by Windermere and Ullswater. The average depth was calculated at 134½ feet, and the lake next to it in depth is Crummock Water, with an average of 87½ feet. The average depth was 52 per cent. of the maximum, a smaller ratio than for Buttermere and Crummock, but larger than for any of the other lakes.

The configuration of Wastwater is severely simple. Along the axis it deepens with increasing slowness to 250 feet one mile from the head, remains nearly flat for a mile further, sinking only to 258 feet at the deepest place, and in the third mile the ramp rises less regularly to the surface at the outflow. Laterally, the isobaths cling closely to the coast-line, the inflections of which are followed, though with diminishing distinctness, to the greatest depths. In the middle third of the lake the average gradient of the slope below water on the right side was about 1 in 2·3 from the surface down to 200 feet, while on land an equally steep slope was not found until one ascended the hills for 300 feet above the lake, and a considerable distance from it; so that here there was no continuation of the sub-aërial slope of the valley-side, but a resumption of steepness after interruption by a broad strip of land of gentler gradient. On the left side, under the screes, the slope on the average of a mile was 1 in 1·5, and at one point at least the average angle from the shore to a depth of 200 feet was 1 in 1, or 45°. This was steeper than the scree, but as a rule the slope was exactly the same, so that if the lake were dried the screes would be seen rising from a level plain 200 feet below the present surface of the water, with a magnificent sweep upward of 1700 feet.

It is remarkable that the area of greatest depth lies fairly in the centre of the lake, not showing any tendency to lie nearer one side than the other. Almost one-half of the area of the lake is deeper than 150 feet. The area beneath 200 feet, that is, below sea-level, is 217 acres, and of

this nearly 100 acres are within the isobath of 250 feet. This plain, one mile long and almost a quarter of a mile wide, undulates into one gentle dip of 8 feet to the deepest soundings of 258 feet, which occurred in several places. Wastwater deprived of water would present a singularly impressive appearance, with its steep wall of screes frowning above its long level central plain.

Representative sections across Wastwater are given on the margin of Map V. in No. 1 across the centre, showing the wide central plain and the steeper slope on the east than the west side. Section 2 shows how, at the lower end, the slope on the west side becomes much more gradual, while that on the east continues steep, giving to the ramp the appearance of a long gentle slope meeting an abrupt short one. Section 3, taken close to the upper end, shows how the flat-bottomed character is preserved to the very extremities.

The coast of the lake varied in its character. Along the right shore it was usually rocky, except where covered by the pebbles of stream deltas. The little rocky bays between rocky headlands were in all cases under 12 feet deep, the isobaths running unaffected outside them, but in the case of deltas the contours were distinctly flexed to a great depth. At the south end of the lake the river Irton escapes, forming first a wide, shallow basin under 10 feet in depth, and, unlike the rest of the lake, containing water-plants. It was separated from the lake by a sharp headland of sand and shingle, which, with boulders lying on its lakeward face, formed the southern end of the lake. On the left shore along the screes the large broken stones went down to a great depth, being distinctly felt by the sounding-line at 120 feet.

The deposits brought up by the tube-lead were interesting. Outside the line of stones off each shore there seemed to be a belt of orange-yellow clay, very tenacious and plastic, sometimes pure, at others mixed with minute pebbles. The clay varied in colour, growing redder toward the south. The whole of the flat floor of the lake was covered by a very soft incoherent mud of fine grain, and when wet possessed of a peculiar grey-greenish-brown colour; but at the southern end of the lake, on the ascending ramp, a few soundings brought up a peculiar mud of deep chocolate colour, unlike any other that was found.

A few temperature observations were made on July 11, showing 63° on the surface in the centre, and 66° at the southern end of the lake, the wind blowing strongly from the north. The central temperature sounding showed the warmth to be 61·0° at 60 feet, 44·8° at 90 feet, 43·4° at 120 feet, and 42·1° on the bottom at 230 feet, the depth not being great enough to allow the temperature of maximum density to prevail unchanged.

IX. Coniston Water.

Coniston Water, running parallel to the lower reach of Windermere, and very similar to it in outline, has an area of 1·89 square mile, being

thus slightly smaller superficially than Derwentwater or Bassenthwaite. Since its extreme length is almost 5½ miles (5·41), the average breadth of the lake is only 0·35 mile, or 600 yards. The widest part of the lake is slightly less than half a mile (870 yards), in the bay south of Church Beck. The upper half-mile and the lower mile and a half of the lake taper from the average breadth to mere points, while the whole central portion remains of almost uniform width, except for the minor accidents of rocky or deltaic promontories and their accompanying bays. In this particular its form differs from the square-ended lakes of the western and eastern mountain groups. The lake is fed by a drainage area of 23 square miles, equal only to 12½ times the water surface. This is proportionally the smallest drainage area in the district—Derwentwater, which comes next to it, receiving contributions from 15½ times its water area.

The lake, as a whole, lies north-north-east and south-south-west, the lower mile turning more nearly into a north and south direction (see Map VI.). The slopes of the hills along the eastern side are more continuous and rather steeper than those on the west. The slope is everywhere more gentle than that round the other mountain lakes considered in this paper, and at the head, on the right side, where the village of Coniston is situated, there is an extensive low plain. The stream which enters the head of the lake is short and insignificant. The most important tributaries, the Yewdale Beck coming from the north, and Church Beck from the north-west, enter three-quarters of a mile from the head on the right side, where they have built a large conjoined delta, which is extending rapidly. We were told that a boulder on this delta, now 20 yards inland from the lake, was always surrounded by water twenty or thirty years ago. Several small streams flow in along the right shore, farther south, each forming a little deltaic promontory; but Torver Beck, 1½ mile from the southern end, is the only one of importance. The becks on the left side are more numerous, but smaller and shorter. From Peel Island to the outlet of the lake the left shore changes its character, becoming abrupt and rocky, with firmly outlined cliffy headlands and beautiful rock-encircled bays. Peel Island itself is a mass of rock clearly glaciated, and rising from deep water. It closely resembles the islands in Ullswater, although lying near the shore of the lake. Fir Island, on the other hand, lying close to the left bank halfway down the lake—indeed, touching the shore when the water is low—is a marked contrast, being low and flat, a mere pile of stones, like the islands of Derwentwater. The lowest half-mile of Coniston is almost cut off from the rest of the lake by a series of long tongues of low sandy ground running out from the left shore, and the plain at the outlet is extremely low and flat.

The altitude of the water surface was fixed by the Ordnance Surveyors on June 26, 1888, as 142·9 feet above sea-level. We were

fortunate in finding a bench-mark of 144·0 feet cut on the stone wall of Kirby Quay, and as this was 1·5 foot above the surface of the water, the altitude during our survey was exactly 142·5 feet above sea-level. The lake was said to be about 2 feet below its average level, and the total range which had been observed (though not, I believe, recorded) at the Gondola pier at Waterhead was 6 feet. We were told that a change of level as great as 2 feet might occur in a single day after heavy rain; but, without questioning the truth of the statement, I am inclined to think that a strong wind blowing steadily up the lake might have more to do with this effect than the inflowing of rain-water, the surplus of which, reaching the lake, would require to be 2 inches over the whole drainage area, or a probable total fall of from 4 to 5 inches, if it were to raise the level all over by 2 feet. The captain of the steam-gondola, a very observant man, said that when the wind blew steadily up the lake he had measured waves 65 feet long from crest to crest, and 5 feet high from trough to crest. We ourselves noticed that a breeze raised much higher waves on Coniston than on any of the shorter lakes, on account, no doubt, of the greater "fetch."

Our work on Coniston occupied the 5th, 6th, 7th, and part of the 8th of July, 1893, in which time 53 sections were run, of an aggregate length of 18 miles, and including 576 soundings, which were spaced at 32 to the lineal mile of section, or 305 to the square mile of area. The cubical contents of the lake, at the level at which we found it, were estimated at 4,000,000,000 cubic feet, and the average depth came out as 79 feet, the same as for Windermere.

Above the delta of the Yewdale Beck the upper half-mile of the lake was found to be a flat shallow, enclosing only a very small depression, a little deeper than 25 feet, at the upper end. This shows that the lake-head is silting up much more rapidly from the Yewdale Beck on the south than from the little stream on the north—a state of matters found in no other lake so distinctly, although both Ullswater and Haweswater indicated similar action at greater depths.

The lowest half-mile of the lake at the outlet is shallower and flatter than the upper, but, descending abruptly from these flats, a single deep trough occupies the greater part of the lake, measuring $4\frac{1}{4}$ miles between the ends of the 50-feet isobath. This is, with the exception of the lower trough of Windermere, than which it is deeper, the longest straight depression of equal depth in the Lake District. The steepness of the gradient of the sides of the trough varies considerably from point to point, the isobath of 50 feet being much less indented than the coast-line. The average slope from the coast down to the floor of the lake at 100 feet depth is about 1 in 5 along the eastern side, and 1 in 4 along the western side—an arrangement which is somewhat remarkable, because the valley sides above water are both steeper and more continuous on the east than on the west. The disparity disappears on considering the

interval between the 25 and 125 feet isobaths, which show nearly uniform gradients rather steeper than 1 in 4 on both sides. The section across the central plain shows the familiar steep sides and flat floor (Sect. 2, Map VI.), but both to the north and south of the greatest depth, which lies exactly in the centre of the lake, there is an approach to a condition of more gentle lateral slopes and a narrower plain. This appears in Section 3 on the south, which also shows the bank at the east side on which the rocky Peel Island stands, and in Section 1 on the north, which indicates a curious platform projecting from the lateral slope south of Lord's Point on the east side, at a depth of between 60 and 70 feet. The 50-feet curve does not show any indication of this shelf, while the 75, 100, and 125 isobaths swerve sharply from their normal trend. When these shallow soundings were first found, I took them as an indication of a bar dividing the trough into two basins, and accordingly ran an extra section across, which showed that the deep water near the eastern side is quite continuous. North of Lord's Point there is a smaller but similar shelf. The steepest slopes found in the lake are 1 in 2 at the west end of Section 2 (from 25 to 125 feet), and 1 in 2 off the delta of Beck Leven on the west side (from 0 to 100 feet). Judging from the configuration, the true head of the lake, turning a little to the left, ends squarely against the steep front of the Yewdale delta. The deepest part of the plain in the centre includes 110 acres at a depth over 150 feet, but this plain is neither so extensive nor so flat as those of Wastwater and Crummock. The deepest point found in it was 184 feet. The 150-feet contour indicates two depressions over that depth—one the central plain referred to above, the other an area lying about half a mile farther north, the deepest water in which was 151 feet deep. If the water were reduced to sea-level, there would remain two small lakes, the southern measuring 1½ mile in length and a quarter of a mile in breadth, and having a maximum depth of 42 feet; the northern one separated by a quarter of a mile, being only 9 feet deep, three-quarters of a mile long, and perhaps 200 yards wide at the most. Quite possibly the two might be connected by a channel, and give a long shallow lake of 2¼ miles.

The accidents of the bench or shore flat were somewhat varied. In the very shallow stretch along the shore south of Church Beck delta, there was a very thick growth of sedges and rushes in water of about 2 feet deep, through which it was impossible to push the boat up to the coast-line marked on the maps.

The contrast between Fir Island and Peel Island has been already noted. From Peel Island long ledges of rock run north and south, just showing at the surface at their highest points, while deep water lies immediately to the west. These rocky shelves run mainly from north to south through the channel separating Peel Island from the shore, and although the greatest depth in that channel was 12 feet, it required a

good look-out and careful steering to get the boat, drawing 18 inches of water, through the reefs. The line of 25-feet soundings runs outside the whole group, and clears everything.

A small bank of stiff clay, with only 3 feet of water on it, lies about 50 yards off the east shore, between Brantwood and Coniston Bank, there being 12 feet of water between it and the shore.

The sediments from this lake on the whole resemble those in Wastwater. Stones, pebbles, and gravel line the shores; beyond these in many places there are beds of stiff clay, and in the centre fine soft greenish-brown mud is everywhere found.

Temperature observations off Kirby Quay on July 5 showed the surface water to be at 63·4°, and the bottom, in 30 feet, at 60·9°. When looked at in connection with the temperature soundings made next day on the Central Plain, these figures show that the water at the upper end of the lake had been pretty thoroughly mixed, probably by the wind. Over the deepest water of the lake there was a layer 12 feet deep of uniform temperature, 67·2°; at 18 feet it was 65·5°, at 30 feet 58°·7, thence it cooled rapidly to 46·0° at 60 feet, and 44·3° at 120 feet. The bottom temperature could not be ascertained on this occasion, as the only line available for the thermometer was too short.

X.—Haweswater.

Although the nearest lake to a main line of railway, Haweswater is perhaps the least-known sheet of water in the Lake District. Its area

FIG. 12.—BIRD'S-EYE VIEW OF HAWESWATER FROM SPUR OF HIGH STREET.
(*From a Photograph by H. R. Mill.*)

is 0·537 square mile, and as its extreme length along its slightly curved axis is 2·33 miles, the average breadth appears as 0·23 mile, or 405 yards. The drainage area measures about 11 square miles of exceptionally steep and rugged mountain sides. The valley in which Haweswater lies is formed by the junction of a number of tarn-fed mountain streams at the base of Harter Fell, and runs between the steep slopes of High Street on the west and Naddle Forest on the east (see Map VII.). The upper end of Mardale is flat, and is probably an old lake-bed; the Mardale Beck,

which originally crossed it in winding loops, has been artificially straightened, and now flows into the lake at the south-eastern corner; traces of the old course flowing in near the south-western corner still remain. The head of the lake would be square but for the rounded delta of Whelter Beck, which occupies the south-western angle. For a mile and a half from its head the lake is known as High Water, and there it preserves an average breadth of about a quarter of a mile, with coast-lines closely following, in the main, the curves of the hillside contours. On the right side Guerness Gill comes in on a flat delta, causing a slight projection on the coast; but Guerness Neb and Boulderstone Neb are sharper promontories, flat also, and not associated with streams, but covered with large boulders. On the left or western shore of High Water the indentations are less marked, and there are no streams longer than half a mile, until High Water is terminated by the huge delta of Measand Beck, which abruptly narrows the lake from half a mile to little more than 100 yards. This delta measures one-third of a mile along its base, and is half that length along its front, the narrow channel which it leaves against the right bank being termed the Straits. The lower end of the lake, beyond the Straits, is three-quarters of a mile long and 300 yards wide, and bears the name of Low Water. No streams enter it. The Measand delta is the central and most prominent feature of Haweswater. The view of the lake from any of the spurs of High Street shows perfectly how accidental it is to the scenery of the region—a piece of modern architecture, geologically speaking, with no sort of relation to the primitive plan. Seen from above (Figs. 12 and 13), Haweswater appears to lie in a deep trough in a mountainous plateau, with steep slopes falling from the plateau brow to the water's edge, and here and there low "nebs" and smaller deltas appear touching the steep walls as the sheet of water does, and only to be distinguished from it by their colour. The great delta with its cultivated fields, which form the only arable land of the district, looks as if it were a huge earth-covered raft moored to the shore; by its flatness claiming affinity rather with the level water-surface than the steep sloping valley faces. Measand Beck enters High Water on the southern edge of the delta in two branches. It comes down by a picturesque "force" through a rocky gorge, which, when climbed, is found to open into a flat-bottomed valley 500 feet above Haweswater. Across this valley the beck meanders through the peat, and at its outlet it cuts through a bed of stratified sand, an unmistakable lacustrine deposit. The steep and rugged walls of this lateral valley rise abruptly from the peat-bog known as Fordingdale Bottom, and present exactly the picture which we have already described in imagination as a drained mountain lake. At the upper end some well-preserved glacial mounds and eskars are to be seen (Fig. 14). There is no evidence, so far as I know, to connect the emptying of this lake chronologically with the building of Measand delta, but it seems possible that either by ice-action or flood-action a vast torrent of

stones and mud brought down the bulk of the deltaic material in a very short time, for in no other case in Lakeland do I know of so large a piece of finished work resting under the hand of a mountain torrent. Whatever its origin, we see here an advanced stage of the process which, when completed, has cut off Buttermere from Crummock, and Derwentwater from Bassenthwaite.

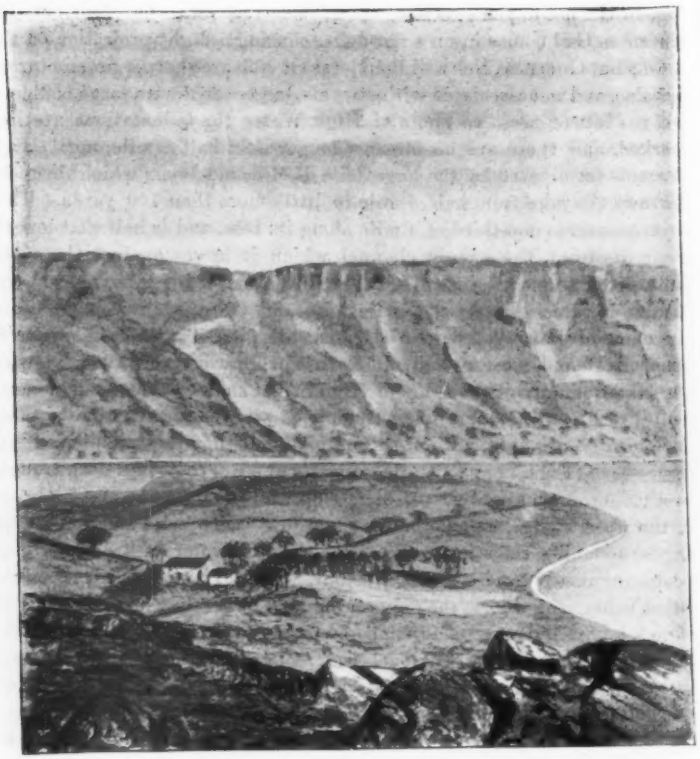


FIG. 13.—MEASAND DELTA FROM ABOVE.
(From a photograph by H. R. Mill.)

The northern or down-lake edge of the delta turns sharply in from the end of the Straits, while the southern edge runs round from the Straits in a gentle curve, forming the quadrant of a circle. The northern edge is composed of sand, covered with short grass, and slopes gently into the water. But in the middle of the Straits the sandy shore changes abruptly to a beach of shingle, falling steeply into the lake, and heaped up along the edge a little higher than the flat land behind. This shingle

beach is devoid of grass, but thickly grown with small shrubby willows, with larger trees behind. It would seem that the down-lake current, intensified by the constriction at the Straits, and often accelerated by a south-west wind, carries the *débris* brought down by the beck along the front of the delta, dropping the pebbles and shingle along the southern edge, and only sweeping sand and mud round the curve.

The whole coast-line of Haweswater was diversified, like Ullswater, by boulders large and small, usually forming a single row just at the water's edge. At one or two points on the west shore, rocks cropped out. It was noticed here that the rocks, about 3 inches above water-level, were marked by a band of white colour, perhaps 4 inches wide

FIG. 14.—FORDINGDALE BOTTOM, SHOWING GLACIAL REMAINS.
(*Photograph by H. R. Mill.*)

on perpendicular parts, and spreading widely on gentle slopes. This white band appears bounding the entire lake in some of the photographs taken from a height, but it disappears when the stones are wet. It is probably a calcareous deposit from the water, but it might possibly be diatomaceous. It was not thick enough to scrape off; but as the phenomenon did not appear so distinctly in any other lake we visited, it might be worth while to make a thorough examination of it in this case.

The shallow floor of Low Water was covered with weeds, growing vigorously; but, except for some sedges at the upper end of High Water, there were no signs of aquatic vegetation in the larger body of water.

The altitude of the lake-surface is given by the Ordnance Survey as 694 feet. It is the highest lake we sounded, and only mountain tarns are found at greater altitudes. The boatman considered that the extreme fluctuations of the lake-level did not exceed 3 feet.

Mr. Heawood and I sounded the lake on March 24 and 26, 1894, and we are indebted to G. Little, Esq., of Penrith, agent for Lord Lonsdale, for the free use of the boat kept on the lake. Twenty-six sections were made, measuring in all 7½ miles, and including 228 soundings. The average closeness of the soundings was 30 to a mile, and their completeness is indicated by 403 being made per square mile, the lake having been surveyed more closely than any other except Derwentwater. The volume of the lake, deduced from the contoured map, is 589,600,000 cubic feet, which gives by calculation 39½ feet as the average depth.

Low Water was found to be very shallow; a small patch near the Straits alone exceeded 25 feet, and in that there was a single sounding of 52 feet. Although interrupted by the delta, this patch of deep water lies in the line of the main trough of High Water, and indicates that the deltaic material has filled up a section of that trough right across the lake. The maximum depth in the Straits was only 22 feet, and in most parts of this narrow channel the depth was under 10 feet. The section across the southern end of the Straits (Section 1, Haweswater, Map VII.) shows that the slope is much steeper off the face of the delta than on the opposite shore. The section (No. 2) across Low Water, just north of the delta, shows the way in which the accumulations have shallowed the water on the west side as compared with the east. The main depression in High Water exceeds 50 feet in depth for nearly a mile and a half. At its upper end the slope is steepest at the very head, and again off the Guerness Gill delta. In its lower half the west side is much steeper than the east, although the lower slopes of the hills are equally steep on both sides. The steepest sublacustrine slopes off the mouth of Guerness Gill on the right, and of Nook Syke on the left shore, were one in three, from the surface to 50 feet. Along the deepest part of the trough, rather nearer the north end than the middle of High Water, the average gradient of the left (western) lateral slope down to 75 feet was 1 in 4; that of the right lateral slope was scarcely steeper than 1 in 7. Near the head of the lake there was a depression below 75 feet, in which the deepest sounding was 78 feet, and this shoaled northward to 66 feet, deepening again opposite Nook Syke to a small patch over 100 feet, in which the maximum sounding of 103 feet was found.

The main trough of Haweswater is not so nearly flat-bottomed as that of the other mountain lakes. Section 3 across the deepest part shows that both sides slope, the western most steeply, towards the deepest line; while Section 4 across the upper and shallower depression

shows the great steepness of the slope of Guerness Gill delta on the east, and approaches more nearly to the flat-bottomed character of Wastwater and Crummock. If we may assume, although it is an assumption which has no direct evidence to support it, that the flatness of the central plain of a deep lake is evidence of its having been long exposed to sedimentation, the more angular build of Haweswater would indicate that it is more recent in its origin than the western group of lakes, thus suggesting the origin of the Measand delta from some more rapid cause than normal sedimentation.

Temperature observations were made on March 26 in the deepest part of High Water, when the water was found at 41·0° from the surface to 12 feet, and at 40·3° from 30 to 75 feet, while it was 39·7°, or practically at the maximum-density point, on the bottom in 100 feet. In Low Water the surface was at 43·8°, and the bottom in 27 feet at 42·6°, thus showing the more powerful effect of solar heating in shallow water.

The samples of sediment obtained were chiefly a coarse-grained, almost sandy, grey mud, and no indication was found of clay on the bottom; but as the sounding-tube was not always attached to the lead, I would not speak positively as to the absence of clay.

XI. Ullswater.

The only two lakes of the eastern system of drainage are Haweswater and Ullswater, the latter second only to Windermere in size among the lakes of the district, and the most complicated of all the narrow lakes in its configuration. Its area is 3·436 (or roughly 3½) square miles, and its length, measured along the winding line which marks the centre of the lake, is 7·35 miles. Hence the average breadth of the lake is 0·47, or nearly half a mile (820 yards); while the extreme breadth at right angles to the axis of the lake is 0·62 mile, or 1100 yards. The total drainage area measures about 56 square miles, being thus fully sixteen times as large as the water surface (see Map VII.).

While most of the lakes of the district have a gently curved form, Ullswater presents two abrupt changes of direction, allowing the lake to be divided into three reaches. Starting from the southern or upper extremity of the lake, the first or Upper Reach runs for a little over 1 mile due north to the island of House Holme. The Middle Reach is 3 miles long, running east-north-east from House Holme, and gradually narrowing to the line, joining Skelly Neb and Geordie's Crag, where the lake is at its narrowest—only 430 yards from point to point. The lower or Northern Reach is also 3 miles in length, and runs nearly straight from Howtown Wyke, the west side of which appears to close it, in the direction north-east by north, maintaining a nearly uniform breadth all the way. The upper part of this reach is continued into the Howtown valley rather than into the Middle Reach of the lake.

Patterdale, which extends southward from the head of Ullswater, is traversed by the Goldrill Beck, which enters almost in the centre of the straight shore terminating the lake. Its water is derived from a number of tarn- and torrent-fed tributaries coming in from Grisedale (with Grisedale Tarn) and Deepdale on the west, and from Brothers Water and the Kirkstone Pass, with Hayeswater and the Angle Tarn on south and east. Half a mile farther down the lake, on the left or western side, Glenridding Beck flows in on a lateral delta which is growing very rapidly and has formed a marked constriction of the lake. On fixing the position of this delta by sextant bearings, we found that its edge was 200 feet farther out in the lake than in 1880, when

FIG. 15.—ULLSWATER FROM ABOVE GLENRIDDING, SHOWING ISLANDS AND GREAT BEND.
(*Photograph by Mr. Herbert Bell, Ambleside.*)

the Ordnance Survey was made. It has its origin in the Red Tarn and other reservoirs, and is more energetic as a silting agent than it would naturally be, on account of the extensive lead-mines on its course, the crushed *débris* from which it carries down. Glencoin Beck comes in with a much smaller delta at the junction of the Upper and Middle Reaches, also on the left side; but on the right side there are no tributaries, except short torrents after rain. The Upper Reach is rugged and picturesque in its coast-line; the whole, except the alluvial flats on the south, and at the mouths of Glenridding and Glencoin, being bare rock descending abruptly into the lake. The hills all round rise steeply to heights exceeding 2000 feet, and on the right shore the slope is most continuous and steepest, on the flank of Place Fell. At the upper end of the reach, the slope of the land, on the average of 300 feet, under Silvery Crags, descending from Silver Hill, is as steep as 1 in 1·3, while on the opposite side Stybarrow Crag is in parts even more abrupt.

The Middle Reach receives more streams than the upper, as its abrupt swerve to the eastward causes it to cross the mouths of a series of long north-running valleys, which carry the drainage parallel to the western edge of High Street. For a mile from Silvery Crag, the right shore is formed by a fine scree of large angular blocks of stone, tufted in summer with the parsley fern, having an average slope of 1 in 1¼ for the first 400 feet above the lake. The base of this slope cuts the water in an almost straight line, unbroken by bay or promontory, the blocks

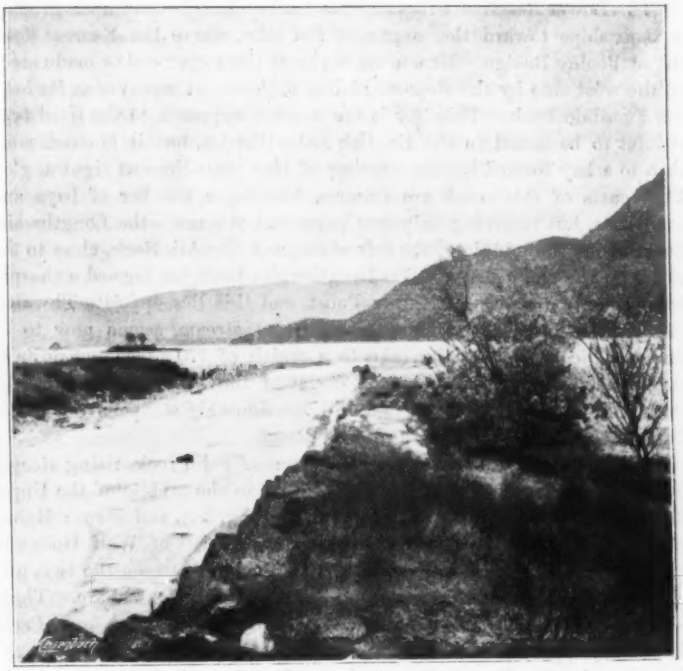


FIG. 16.—DELTA OF GLENRIDDING BECK, FROM THE LAND.
(*Photograph by Mr. W. Ellison.*)

of stone having settled themselves almost as regularly as if placed by hand, in the form of a bulwark. Then, on the right shore, there is a mile in which the steep hill-slopes sweep back, forming two valleys, across the mouths of which the Scalehow and Sandwick Becks have laid down a broad alluvial meadow, running out their deltas into two prominent spits of lowland defining three bays of gentle curve. The last mile of this shore is steep and rocky again, on account of the circular mass of Hallin Fell, which a rise of the lake-level by 100 feet would convert into an island a mile in diameter. It forms a series of rocky

points and bays, terminating the Middle Reach in Kailpot Crag and Geordie's Crag. The left or northern side of the Middle Reach is also steep, although less so than the opposite shore, and it is wooded as a rule. The only important accidents of the coast-line are Skelly Neb at the lower end, defining Gowbarrow Bay to the west of it, and Aira Point, a mile from the upper end of the reach, formed by the delta of Aira Beck, which drains Deepdale. This delta is larger than that of the Sandwick Beck on the right shore.

The Lower Reach of Ullswater has banks which become more gradual in their slope toward the mouth of the lake, where the Eamont flows out at Pooley Bridge. Howtown Wyke at the upper end is made steep on the west side by the slope of Hallin Fell, and it receives at its head the Fusedale Beck. This bay is the nearest approach to the fjord type of inlet to be found in the English Lake District, but it is much more akin to a bay formed by the meeting of two coast-lines at right angles. The coasts of this reach are sinuous, forming a number of bays and headlands, but receiving only two important streams—the Longthwaite Beck, about the middle of the left shore, and the Aik Beck, close to the outlet on the right shore. The Longthwaite Beck has formed a sharply pointed delta, named Castlehows Point, and this lies opposite Thwaite-hill Neb, a low projection with which no stream seems now to be associated, constricting the lake to a width of 470 yards, not quite so narrow as at Skelly Neb. At the outlet of the lake on the left side, Dunmallet, a conspicuous wooded hill, considerably steepens the gentle slope of the land bordering the Lower Reach.

The islands of Ullswater are all masses of solid rock, rising steeply from a great depth of water. Wall Holme in the middle of the Upper Reach (shown as a flat island with trees in Fig. 16), and House Holme at its lower extremity (a conical island to the left of Wall Holme in Fig. 16), rise almost in mid-channel; Ling Holme between the two, and Cherry Holme nearer the upper end, lie nearer the right shore. There are also two shoals marked for the safety of the steamers—one, Peely Slapehold, opposite Horrockwood, near the middle of the Lower Reach; the other in Gowbarrow Bay. The rocky islets all bear clear marks of ice-action, being smoothed and striated, with gently rounded curves toward the south, where the ice-markings remain more distinct under water than on the dry surface. The northern sides of the islands show rough angular fractures, indicating the advance of ice from the south.

On the fine gravel beach of Aira Point, a little ridge of gravel, about 2 inches high and 8 inches wide, was observed running parallel to the lake about a foot from the water's edge, evidently the result of wave-action on the previous day, when the weather had been squally. Water-plants were occasionally observed in the shallow water of some of the lateral bays, and at the ends of the lake, but they were never so luxuriant as those in Derwentwater.

The altitude of Ullswater was determined by the Ordnance Surveyors as 476·6 feet above sea-level. On the occasion of our visit, the water was said to be close to, but rather above its usual level. A distinct mark was observed on the cliffs near Glenridding House about 8 inches below the surface of the water, and another fainter mark was seen about 1 foot 6 inches or 2 feet above the actual surface. The fact that the submerged rock in Gowbarrow Bay had exactly 3 inches of water over its highest part will enable the exact level of the water to be determined at any future time.

We were occupied with the soundings of Ullswater from June 29 to July 3, 1893, and in that time we made 64 sections, measuring 25 miles in total length, and including 831 soundings. This was at the rate of 34 soundings per mile of section, or 242 per square mile of area. The volume of the water in Ullswater was calculated from the contoured map as 7,870,000,000 cubic feet, from which the average depth of 83 feet was deduced. This depth is only exceeded by Wastwater and Crummock. The deepest water found in the lake was 205 feet.

The configuration of Ullswater shows a certain relation to the three reaches in the deeper parts, but to the depth of 50 feet the lake may be looked upon as a single depression, extending from within 150 yards of the head to about half a mile from the mouth; the shallowing at the outlet is, however, quite abrupt from the surface to the depth of 25 feet, and then becomes gradual. The isobath of 50 feet follows the coast-line closely as a rule, coming nearest to it along cliffy promontories and the edges of growing deltas. It diverges considerably from the land at three points along each shore. On the right side the submerged shelf, from which Cherry Holme rises in the Upper Reach, carries the 50-feet contour halfway across the lake, and in the Lower Reach water less than 50 feet in depth fills the south-western half of Howtown Wyke, while from the northern side of Thwaitehill Neb a broad shallow runs nearly across the lake, and is met by another of less extent from the left side, almost separating the northern end of the trough from the main body. The second sharp deflection of the 50-feet line from the left shore surrounds the shoal off Horrockwood, and the third occurs where the line runs across the mouth of Gowbarrow Bay, where the second marked shoal is situated.

The isobath of 100 feet defines two distinct hollows, and in every part, except, of course, at the ends of the depressions, it follows the 50-feet line closely. The southern hollow extends from Wall Holme in the middle of the Upper Reach to opposite Hallin Fell, a distance of $3\frac{1}{4}$ miles. It is separated by three-quarters of a mile of shallower water from a patch exceeding 100 feet in depth, which runs from Howtown Wyke to Peely Slapehold, a distance of one mile.

Considering the deeper water, we see that in the Upper Reach depths exceeding 125 feet extend across almost the whole breadth of the

lake from Wall Holme to House Holme, and in the centre there is a patch more than a quarter of a mile in diameter which is bounded by the isobath of 150 feet; the deepest sounding found in it was 162 feet. The section across this depression from Ling Holme to the left side (Section 1) shows slopes of extraordinary steepness. A fall of 150 feet from the edge of Ling Holme takes place in a horizontal distance of 125 feet, the gradient being 1 in 0·83. This is very exceptional, and doubtless represents a terrace from which the island rises, with a precipitous slope in continuation of the steep slopes of Silvery Crag, which towers above. The slope of the left side of the depression is just half as steep, being 1 in 1·66. The bar which divides this depression from the great trough of the Middle Reach is about 300 yards wide between the 125-feet isobaths on north and south; and the pyramidal mass of rock, the summit of which emerges in House Holme, occupies its central part. On the right the channel defined by the 100-feet isobaths between this obstruction and the shore is 100 yards wide; on the left it is 200 yards, the whole breadth of the lake at the point being 770 yards. Considerable interest attaches to this residual mass of rock in the centre of a deep channel, with much deeper water to south and north of it than to east or west, and five lines of soundings converging on its summit enable us to speak with some confidence. The isobaths of 25, 50, 75, and 100 feet surrounding House Holme show that it is a triangular pyramid, the base being almost equilateral, and measuring 200 yards in the side on the 100-feet isobath. One side faces the Upper Reach, running at right angles to the axis of that channel; another side similarly faces the Middle Reach, running at right angles to its axis; while the third is approximately parallel with the left shore. One angle points across the narrow channel to the rocky spur of Silvery Crag on the right, and one is directed due north. Section 2 (of Ullswater, Map VII.) is drawn through the angle pointing to Silvery Crag, and at right angles to the side facing the left shore. The somewhat similar profile of the channel at Wall Holme is given in Section 3. In the longitudinal section (No. 5) the profile is drawn through the centre of Wall Holme and House Holme, and also in dotted lines through the deepest part of the channels on the right and the left of the islands. These will probably be found most interesting by glacial geologists.

The Middle Reach of Ullswater is one long trough approximately flat-bottomed, with sides parallel to the coast-line, and following all its larger windings. This is particularly marked in the case of Aira Point, which is continued in a steep spur to the floor of the basin, inflecting every isobath down to 175 feet. Depths over 150 feet occur along a distance of 2 miles, and depths over 200 feet in a distance of half a mile, covering an area of 36 acres. The depression is deepest at the southern end, where 205 feet was the maximum sounding obtained. Section 4 shows the form of the lake-bed at the deepest part, bringing out the

fact that the slope on the right side is much steeper than that on the left, and suggesting that flat-bottomed troughs are only obtained when the lateral slopes on both sides are equal. Here the deepest point lies only 300 yards from the right shore and 680 yards from the left, the lake at the place being nearly at its widest. The average sublacustrine slope on the right side down to 150 feet of depth is 1 in 1·5, while the gradient on the left side (excluding the steep slope off Aira Point) is only 1 in 4·7, corresponding closely to the gradients of the hillsides on the two shores of the lake. The similarity of the scree-coast of Ullswater along its deepest tract with that of Wastwater is remarkable. Following the line through the deepest water of the Middle Reach, we observe it deepen abruptly to its maximum half a mile from House Holme,

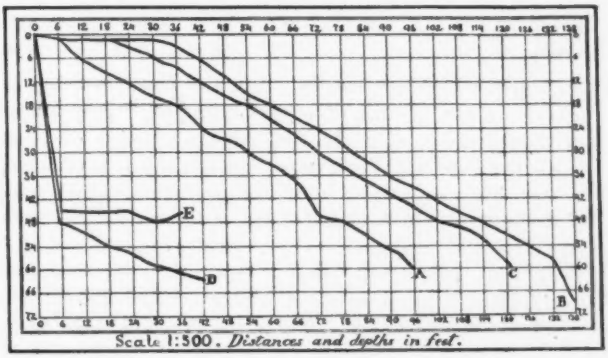


FIG. 17.—SECTIONS OF EXCEPTIONAL SLOPES IN ULLSWATER IN CORRECT PROPORTION.

and then shoal very gradually to its junction with the lower reach at Skelly Neb, 2½ miles away.

The Lower Reach is the shallowest of the three. In the mile-long hollow at its upper end, which exceeds 100 feet in depth, the maximum sounding was 125 feet at the southern extremity.

Several sets of detailed soundings were made in Ullswater off particularly interesting points, the soundings being taken at measured intervals of 6 feet. They show well the characteristic front of the deltaic cone, and also the gentle slopes of the stony shoals and the abrupt descent of precipitous cliffs.

The first group refers to the great delta at Glenridding Beck, the detritus for the construction of which may be looked on as artificially prepared at the mines up the valley. Section A (Fig. 17) is practically the end of Section 2 in minute detail, being taken at right angles to the shore, straight out toward the axis of the lake from the centre of the delta; Section B, at right angles to the shore, was directed south-eastward from the southern edge of the delta, whilst Section C was similarly taken from

the north-eastern edge north-eastward. The three thus determine the slopes along the face of the delta.

Distance from shore...	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126	132	138 ft.
Section A, depth	0	1	6	9	12	16	18	24	25	30	33	37	46	48	52	55	60	—	—	—	—	—	—	— ft.
„ B, depth	0	0	0	1	1	1	3	6	10	15	18	22	24	28	33	36	39	43	45	48	52	54	57	60 ft.
„ C, depth	0	1	1	1	3	6	9	12	15	18	22	25	30	33	37	40	43	48	49	52	60	—	—	— ft.

Taking the angle of these slopes from the point where the water began to exceed 1 foot in depth, the average appears to be 32° for A in the centre of the delta, and 30° for B and C on the up-lake and down-lake edges. The lower part of A, below 25 feet, had a slope of 35°, of B 30°, and of C 32°; the upper part of the three slopes had the angle 32°.

Two sections were made from the rocky point on the opposite side of the lake immediately opposite the delta, D being directed north-westward toward the Steamer pier, E south-westward toward Patterdale Hall.

Distance from shore	...	...	...	...	...	0	6	12	18	24	30	36	42 ft.
D, depth	...	...	...	...	...	0	48	51	54	55	59	61	63 ft.
E, depth	...	...	...	...	...	0	45	45	45	45	48	45	— ft.

These slopes are almost exactly 83° in the first 6 feet, and are the best instance in the district of a rock plunging "perpendicularly" into the water, which after the first plunge remains of practically equal depth, the slope of E being imperceptible, and that of D only 21°. The curves on Fig. 17 are drawn in correct proportion, and show the true slopes of the delta face in A, B, and C, and of the steep cliffs in D and E. The water of the lake happened to be unusually clear on several of the days of our visit, and it was possible to see as well as to sound one interesting feature of the shore slope, which was well developed on the left shore of the Middle Reach. This is the bench or shelf formed by wave-action on a readily eroded coast. In its most characteristic form a pebbly flat of very gentle gradient extended into the lake from the coast-line for about 60 feet, the water deepening gradually from nothing to 3 feet. Then an abrupt slope commenced, and simultaneously the pebbles began to be coated with mud. When the boat was held with her bow pointing outward and her stern over the sharp line where the steep slope began, the depth at the stern was 3 feet, and at the bow, 24 feet distant, it was 12 feet. Thus the slope had abruptly changed from 1 in 20, or 2°, to something more than 1 in 3, or more than 18°.

The deposits obtained from the deep water of the lake were everywhere fine soft mud, and in no instances were specimens of plastic clays found of the kind common in Windermere, Coniston Water, and Wastwater.

Temperature observations were made on several occasions, but as the weather was variable, with intense heat and frequent falls of cold rain, it is impossible to compare surface temperatures, which varied from 55·7° on June 29, at the upper end, to 66·2° off Howtown pier on July 3. In the Upper Reach, off Ling Holme, the temperature fell gradually from 56·3° on the surface to 54·0° at 24 feet, and then steadily

to 47·0° at 60 feet, and 43·7° on the bottom in 144 feet. On the same day, in the southern part of the Middle Reach, the surface temperature was 61·9°, that at 60 feet 46·0°, and at 132 feet it was 44·0°. In the lower basin the surface temperature on July 1 was 66·0°, and at 40 feet it was 55·1°, showing that the water was warmed to a greater depth than at the upper end.

XII. Windermere.

Windermere, the largest lake in England, has an area of 5·69 square miles, not including islands, and it measures 10½ miles in total length along the curved axis of the lake, while the direct distance from the head to the mouth, measured across the projecting land of the western

FIG. 18.—WINDERMERE FROM ABOVE WINDERMERE VILLAGE, SHOWING ISLANDS.
(*Photograph by Mr. A. Pettitt, Keswick.*)

shore, is 10 miles. The average breadth of the lake, obtained by dividing the area by the length, is 0·54 mile, or 950 yards, and, although this takes no account of the islands, the difference obtained by including these would be very slight. The widest part of the lake is in the bay north of Millerground Landing, where the breadth at right angles to the axis is 1610 yards, somewhat less than a mile; the same breadth is found in the sharp inlet of Rayrigg Wyke, a little farther south. It is often stated that the north end of Windermere is 1¼ mile wide, measuring from the end of Pull Wyke; but this measurement is not at right angles to the axis of the lake, and so does not correspond to its breadth.

Windermere receives the drainage of 88 square miles, or $15\frac{1}{2}$ times its water area. Although nearly three times as large as Bassenthwaite, Windermere has a drainage area little more than half the size of that of the smaller lake.

Superficially, Windermere may be divided into three parts: the Upper, or Northern Division, which is the widest; the Middle Island Division, in which all the larger islands of the lake are found; the Lower, or Southern Division, which is the longest. These divisions are more than superficial; they correspond to distinct varieties of configuration. The lake, as a whole, is surrounded by a flatter shore than most of the others, and the indentations are more numerous and varied. Its surface is the nearest to sea-level; the surrounding heights also are lower, and the land slopes are steep in comparatively few places (see Map VIII.).

Our work on Windermere occupied five days—from the 4th to the 8th of September, 1893. Eighty sections were made altogether, the combined length of them being $41\frac{1}{2}$ miles. On account of the great simplicity of the structure of the basins, 865 soundings were found sufficient to delineate the main features, though this was at the rate of only 21 soundings in a lineal mile, or 152 per square mile—the smallest number proportionally thought necessary for any of the lakes. The volume of water in Windermere, calculated from the isobaths, is 12,250,000,000 cubic feet—as much as Ullswater and Wastwater put together, and twelve times the volume of Derwentwater or Bassenthwaite. The mean depth comes out as $78\frac{1}{2}$ feet, practically the same as that of Coniston, and less than that of Wastwater, Ullswater, and Crummock. The deepest water found was 219 feet; thus for maximum depth Windermere ranks next to Wastwater.

The northern division of the lake may be looked upon as terminating at a curved line drawn from Rayrigg Hall through Rough Holme and Lady Holme to Bass How. It is 4 miles long, and of nearly uniform breadth, averaging about 1300 yards. For 3 miles from the head the direction of the lake is south-south-east, but at the end of the Troutbeck delta, which narrows the lake to 800 yards, the direction changes to due south, and the breadth increases. The head of the lake receives the conjoint streams of the Rothay, carrying the overflow of Grasmere and Rydal from the north, and the Brathay from Elter Water and Langdale. The stream enters by an alluvial flat on the east side of the picturesque rocky promontories of Gale Nase Crag and Hanikin, which enclose deep bays. (These promontories appear in the left of the picture in Fig. 2.) At the north-western corner Pull Wyke forms a short fjord-like inlet, into the head of which flows the short Pull Beck. Immediately to the south, a wide flat meadow runs back for rather more than a mile, and in it Blelham Tarn lies, only 25 feet above the level of Windermere—Blelham Beck flowing in from it.

No important stream enters on the remaining 3 miles of the west side, which from Wray Crag becomes rocky and steep, the headlands, as a rule, being crags showing clear marks of ice-action. The slopes are thickly wooded, so that the true nature of the land is not readily seen. But from Woodclose Point southward to the end of the Northern Division, the gradient of the lower 200 feet of hillside increases steadily from 1 in 5 at the north to 1 in $1\frac{1}{4}$ at the south. The coast, for all this distance, runs parallel to the higher contours, and has scarcely any indentations not shared by them.

From Waterhead southward the east coast of the Northern Division forms a series of bays and headlands, the latter frequently being low crags; but the land behind is of much gentler gradient, and less wooded

FIG. 19.—WAVE EROSION ON TROUTBECK DELTA.
(*Photograph by Mr. John Thomson.*)

than on the western side. Holbeck comes in just south of Lowwood, on a small but prominent delta. From Waterhead to Lowwood, a distance of about a mile, the gradient of the land sloping up from the lake averages 1 in 6 for the first 200 feet, but further south the contour-lines sweep back up the valley of Troutbeck, and the broad delta of that stream borders the lake for a mile, with a nearly level meadow. South of this delta the shore becomes a little steeper, but although broken by knolls like Miller Brow, the average gradient for the first 200 feet is only 1 in 11 between Millerground Landing and the point opposite Rough Holme, at which we place the limit of the Northern Division.

Along the edges of the Troutbeck delta, which is grass-covered to the water, and at several other points, the shore-line is very ragged, being fretted into a series of irregular little bays with miniature cliffs, one or two feet high, of alluvial sediments evidently cut by waves. (Fig. 19.) No such formations were noticed on the western side, and they are evidently due to the action of the prevailing south-westerly wind, and are similar to the bays of the east shore of Bassenthwaite.

The Northern Division of Windermere forms one deep and uniform basin, the isobaths of which follow the coast-line faithfully, clinging most closely to it along the uniform western side, and along the faces of Holbeck and Troutbeck deltas. Two instances occur in which the isobaths down to 150 feet indicate branches or sublacustrine valleys

FIG. 20.—THE HEAD OF WINDERMERE FROM THE LAKE.
(*Photograph by Mr. John Thomson.*)

running into the main depression. One of these is a deep channel passing through Pull Wyke in line with the valley of the present stream, a remarkable instance of sedimentation not having yet effaced primitive structure, comparable in some ways with the depression of Howtown Wyke in Ullswater, but more pronounced. Section 1 is drawn from south to north across the mouth of Pull Wyke. The other instance occurs on the east coast, south of Ecclerigg Crag, where there is a sharp inflection of the isobaths toward the north side of the square bay, which is bounded on the south by the Troutbeck delta. A similar though less pronounced inflection of the shallower isobaths is shown in the bay south of the Troutbeck delta, and it is possible that these may be indications of the primitive outline of the basin when Troutbeck

entered a wide bay, which it has now filled up, and the inflections represent the angles between the pyramid of river-borne detritus and the original wall of the basin. One peculiarity of this basin is that the slope at the head is nearly as steep as the slope at the sides. It is one of the steepest ramps in the Lake District, resembling that of Buttermere. Depths over 100 feet are found along $3\frac{1}{3}$ miles, this being the longest deep depression in the Lake District, though little longer than that of Ullswater. Of this, an area 3 miles long and nearly one-third of a mile wide is below sea-level. From off Wray Crag to off Pinstone's Point, the deepest part of Windermere forms a curved trough exceeding 200 feet in depth for a distance of one mile, and nearly one quarter of a mile in breadth. This plain lies in the centre of the lake, and is fairly flat, the deepest sounding we obtained being 219 feet. Section 2 gives the best impression of its profile, showing the greater steepness of the eastern slope. The area beneath 200 feet is 107 acres.

The slopes of the deep basin are interesting when compared with those of the valley walls. Off Wray Crag the gradient from the surface down to 200 feet is 1 in 6, and this, except where the comparison is made unsatisfactory by the occurrence of small shallow bays, grows gradually steeper, until off Pinstone's Point it is 1 in 3, the steepest observed. These gradients of the slope are steeper than those of the bordering hills, and where the latter grow steep to the south, the sides of the lake-basin gradually flatten out. On the eastern side the sublacustrine slope from Down's Wood to Ecclerigg Crag, along the whole length of the depression, averages 1 in 6 down to 200 feet; this being very much steeper than the slope of the hillsides.

Toward the Island Division the deep trough of the northern division keeps near the western shore. Section 3, from Slape Scar to Rough Holme, shows this.

The Island Division forms a plateau rising to within 25 feet of the surface of the water, and completely isolating the northern and the southern troughs. An upheaval of only 12 feet would connect Belle Isle, the largest island in the Lake District, with the shore at Bowness on the east side, and through the islets known as the Lilies of the Valley with the west side, thus separating the lake into two. Such an intermediate rise might have enabled the Greta to separate Derwentwater from Bassenthwaite.

The islands are all low and rather flat, Belle Isle being completely surrounded with stones, like the islands of Derwentwater, but also protected by large boulders dropped irregularly, especially round its northern end. The smaller islands to the north-west, Hen Holme, Lady Holme, and Rough Holme, show masses of rock in many cases strongly glaciated from the north. The 25-feet isobath runs from Rayrigg Wyke on the east, round the north and west of Rough Holme, past the west of Lady Holme and Hen Holme, and the north of Haws Holme and

Thompson's Holme to Bass How. The shoal on which the islands stand is not so clearly or simply defined on the south, where the basin of the Southern Division cuts into it on two sides. No streams of importance enter this division, except Mill Beck in Rayrigg Bay; and it is interesting to notice that along the western edge of the lake, from Bass How to the Ferry, the hill-slopes of the Claife Heights are the steepest round all Windermere, and the water beneath them is the shallowest, while on the eastern side the hill-slopes are very gentle up to a height of 300 feet.

The Southern Division of Windermere bears a close superficial resemblance to Coniston Water, with which it runs parallel. It tapers gradually from a breadth of half a mile below the Ferry, until at Lakeside it merges imperceptibly into the outflowing river Leven. At the Ferry near its upper end the breadth is halved by the sickle-shaped promontory on the west shore on which the Ferry Hotel stands, and Ferry Neb on the east. Both coasts are minutely diversified by rocky headlands and bays. On the east side the only large promontory is that at Storrs, off which there are numerous reefs. South of that the coast for 2½ miles is very regular, and the hills rise steeply; then a series of small rocky headlands and bays, with islands lying off them close to the shore, is met with. On the west side the headlands and bays are larger and more numerous. Wanefell Beck comes in on a small delta opposite Storrs Point, and Cunsey Beck, carrying the drainage of Esthwaite Water, forms a more extensive delta, off which is the low island of Ling Holme; a quarter of a mile to the south of it Rawlinson Neb projects, possibly a rocky islet naturally reclaimed, forming now the most prominent headland on its side of the water. To the south the coast runs in sharp bays and abrupt cliffy headlands, often with rocky islets and submerged reefs projecting from them.

Depths exceeding 25 feet run from this basin past the Ferry up both sides of Belle Isle, and in the centre of the space marked off by the south end of Belle Isle, Cockshot Point, and Ferry Neb, there is a small patch over 50 feet with one sounding of 57 feet. For a mile below the Ferry a great bank with depths less than 25 feet occupies the middle of the lake, bearing the small stony island of Ramp Holme, and several shoals which are buoyed for the safety of vessels. The water close to the east shore is very shallow, but a narrow channel separates it from the main portion of the shoal. Depths over 50 feet occupy a channel about 100 yards wide, which, commencing off Ferry Head, runs south close to the west shore, and spreads out to nearly the full width of the lake at Storrs Point. This channel suggests the remnant of an old river-valley by its narrow and sinuous course. The form of the shoal is well brought out in Section 4 from Jemmy Crag on the west to the opposite side. The isobath of 50 feet continues to run very close to the east coast, disregarding the minor inequalities and running outside all the islets. It keeps much

farther out from the west coast except off Black Hole in the south, where deep water comes close up to the rocks. Soundings of 50 feet cease half a mile from the outlet of the lake. Along the axis the Southern Division exceeds 100 feet in depth for a length of 3½ miles from off Storrs Point to off Ringing Crag, nearly a mile from the outlet, and 2 miles of this stretch is deeper than 125 feet, the greatest depth found in the southern division being 144 feet. All the isobaths as a rule remain parallel, but the gradient of the lateral sublacustrine slopes is everywhere more gentle than on land. The average gradient from the surface down to 100 feet on the east side is 1 in 3, and on the west side 1 in 6. Section 6 shows the profile across one of the deepest parts of the basin at a point where the steepest slopes and the flattest bottom are found, the gradient on the east side here being 1 in 1·5 and on the west side 1 in 3. Section 5 is more characteristic of this basin.

The deposits obtained from Windermere were in some respects of special interest. In the deepest water of both the northern and southern basins the mud was of very fine consistency, minutely granular and brown or yellowish-brown in colour. In the shallower water stiff clay was frequently found, often mixed with very small pebbles, and this clay varied in colour in different localities, being sometimes bright yellow, occasionally red or chocolate-coloured, and once or twice salmon-colour, or even white.

Two sets of serial temperature soundings were made in the deepest water of the northern and southern basins respectively. In the former (September 5) the depth was 198 feet, and the temperature, which was 64° on the surface, fell with almost uniform rapidity to 44·4° at 60 feet, and then more gradually to 41·9° on the bottom. In the southern basin, on September 7, the depth was 120 feet. The surface temperature was 62·4°, and at 30 feet it was practically the same, 62·3°; then it fell rapidly to 46·4° at 60 feet, and gradually to 44·8° at the bottom. At depths below 60 feet it thus appeared that the shallower basin contained water 3° warmer than that in the deeper basin at equal depths.

The surface of Windermere was fixed as of the altitude 128·0 feet above sea-level by the officers of the Ordnance Survey on July 4, 1889, the height previously determined having been 133·7 feet. On September 5, 1893, we found by levelling from a bench-mark that the surface of the water was 129·7 feet above ordnance datum, or, since the lake rose a few inches on account of the heavy rains during the last days of our work, the altitude of 130 feet may be safely taken as that to be used in placing the isobaths on the ordnance maps.

Accepting this height, we can see that if the water were drained off down to sea-level, the valley of the Brathay-Leven river would contain three narrow lakes separated from each other. The northern lake would measure 3¼ miles in length, about a quarter of a mile in breadth, and would

be 90 feet deep at its deepest. Three and a half miles south of the end of this lake, and on the southern side of the Belle Isle plateau, the middle lake would be 1 mile long and 350 yards wide, with a maximum depth of 14 feet, and a quarter of a mile south of it a shallow pool half a mile long and 300 yards wide would represent the southern lake.

XIII. Conclusions.

An abstract of this paper has already appeared in the *Geographical Journal* for September, 1894 (vol. iv. pp. 237–246), together with the remarks made on the paper when it was presented to the Royal Geographical Society. The suggestions made on that occasion by Mr. Heawood present so clear a generalization of many of the facts, that they are reproduced at the end of this summary.

The facts dwelt upon in detail for each of the lakes considered are summarized in the three following tables. Table I. gives the numerical

Table I.—Statistics of English Lakes.

Name.	Length miles.	Breadth, yards.		Mean breadth per cent. of length	Elevation of surface above sea, feet.	Depth.			Area, sq. miles.	Volume, million cubic ft.	Drainage area of land.	
						Feet.		Mean per cent. of max.				
		Max.	Mean.			Max.	Mean.				Total in sq. miles.	Ratio to area of lake.
Windermere	10·50	1610	950	5	130*	219	78½	36	5·69	12,250	88·65	15·5
Ullswater.....	7·35	1100	827	6½	476	205	83	40	3·44	7870	55·95	16·3
Wastwater	3·00	880	650	12	200*	258	134½	52	1·12	4128	18·64	16·7
Coniston Water	5·41	870	600	6½	143*	184	79	43	1·89	4000	23·34	12·4
Crummock Water ...	2·50	1000	700	16	321	144	87½	61	0·97	2343	16·80	17·3
Ennerdale Water ...	2·40	1000	800	19	368	148	62	42	1·12	1978	16·95	15·1
Bassenthwaite Water	3·83	1300	950	14	223*	70	18	26	2·06	1023	91·51†	44·2
Derwentwater	2·87	2130	1270	25	244*	72	18	25	2·06	1010	31·83	15·4
Haweswater	2·33	600	405	10	694	103	39½	38	0·54	589	11·20	20·7
Buttermere	1·26	670	620	28	329	94	54½	58	0·36	537	6·50	18·0

statistics for the ten lakes under consideration with regard to length, maximum and mean breadth, ratio of average breadth to length, elevation of the surface of the water above sea-level, the maximum and mean depth, the ratio of mean to maximum depth, superficial area of the water-surface, estimated volume at the time of observation, total drainage area of each lake, and the ratio of that area to the size of the water-surface. For the convenience of readers who may be unfamiliar with the British system of measures, Table II. is given with all the measurements repeated in metric units; the ratios, which do not depend on the units adopted, are not repeated. As this paper is merely a record of work done on a single group of lakes, and not in any sense a treatise on limnology, I have not attempted at present to bring our work into

* Depths determined at time of sounding; other depths ± 2 feet.

† Excluding Derwentwater and Thirlmere drainage areas; including these = 131·2 square miles.

relation with that of foreign workers. The data are presented simply as they were ascertained, and arranged in a convenient manner for subsequent discussion. Table III. gives a set of ratios calculated from the measurements of areas included between successive contour-lines made at the Ordnance Survey Office. It affords some remarkable

TABLE II.—STATISTICS OF ENGLISH LAKES IN METRIC UNITS.

Name.	Length, kiloms.	Breadth, metres.		Depth, metres.		Height of lake surface above sea, metres.	Area, sq. kiloms.	Volume, million cubic metres.	Total drainage area, sq. kiloms.
		Max.	Avge.	Max.	Avge.				
Windermere	17·0	1475	869	66·8	23·8	39·6	14·79	347·0	230·5
Ullswater	11·8	1005	756	62·5	25·3	145·0	8·94	223·0	145·5
Wastwater	4·8	805	595	78·6	41·0	61·0	2·91	117·0	48·5
Coniston	8·7	795	549	56·1	24·1	43·5	4·91	113·3	60·7
Crummock	4·0	914	640	43·9	26·7	98·0	2·52	66·4	43·6
Ennerdale	3·8	914	732	45·1	18·9	112·5	2·91	56·0	44·1
Bassenthwaite.....	6·2	1190	869	21·3	5·5	68·0	5·35	29·0	237·9
Derwentwater.....	4·6	1950	1160	22·0	5·5	74·5	5·25	29·0	82·7
Haweswater	3·7	549	370	31·4	12·0	211·5	1·40	16·7	29·1
Buttermere	2·0	613	567	28·6	16·6	101·0	0·94	15·2	16·9

contrasts with regard to the arrangement of depth in different lakes. Derwentwater and Bassenthwaite being of the same area, average and maximum depth are strictly comparable; but Derwentwater has a far smaller area less than 10 feet deep than Bassenthwaite, showing much more gentle marginal slopes in the latter. The flat-floored, trough-like

TABLE III.—ENGLISH LAKES. PERCENTAGE OF SUPERFICIAL AREA COVERED BY DIFFERENT DEPTHS OF WATER.

LAKE. Feet / Metres (approx.)	0–10 / 0–3	10–25 / 3–7·5	25–50 / 7·5–15	50–100 / 15–30	100–150 / 30–45	150–200 / 45–60	200–250 / 60–75	Over 250 / 75
Derwentwater	35·4	45·0	13·5	6·1	—	—	—	—
Bassenthwaite	43·2	30·8	20·1	5·9	—	—	—	—
Buttermere ...	22·6		15·2	62·2	—	—	—	—
Crummock ...	16·0		11·0	20·0	53·0	—	—	—
Haweswater ...	41·9		22·1	34·3	1·7	—	—	—
Ennerdale.....	39·8		12·8	15·2	32·2	—	—	—
Coniston	25·9		11·2	23·7	30·0	9·2	—	—
Ullswater	17·6		17·6	28·8	18·6	15·8	1·6	—
Windermere...	42·0			21·6	23·0	10·4	3·0	—
Wastwater ...	23·0			16·0	16·6	14·1	16·6	13·7

form of Buttermere, Crummock, and Wastwater is beautifully brought out by the low ratio of shallow water and the very large percentage of area at great depths.

In these tables all the lakes of the district have been considered, except the mountain tarns, the transitional forms between tarns and

valley-lakes, such as Grasmere, Esthwaite, and Hayes Water, and Thirlmere. The omission of Thirlmere, which is a true valley-lake, was made necessary by the fact that it was in the act of being converted into a half-artificial reservoir by the Manchester Water Works while our survey was being made, and, its level being in course of alteration, no satisfactory survey was possible. Nor would the lake in its present altered condition, to which it has not yet become adjusted, be comparable with the purely natural basins we have been considering.

Excluding Thirlmere and the tarns, we may conclude that there are in the English Lake District two main types of lakes, the shallow and the deep. The former includes only Derwentwater and Bassenthwaite, the broadest of all the lakes; they only average 18 feet in depth, and their average depth is only 25 per cent. of their maximum depth, a smaller ratio than for any other lakes. The bed of these lakes may be roughly described as an undulating plain, grooved and ridged into shallow hollows, and low shoals running parallel to the long axis of the lake. The fact that these lakes are separated by a strip of alluvial ground so low that their waters may mingle in heavy floods, shows that they may in some ways be viewed as a single lake, and the configuration suggests that they may have been shallowed by glacial accumulations.

The second, or deep type, the shallowest of which has an average depth of 40 feet, and in which the average depth varies from 36 to 61 per cent. of the maximum depth, showing a steep-sided character, comprises all the other lakes. Ennerdale, however, combines the characteristics of the two, conforming to the deep type in its upper, to the shallow in its lower reach. The deep lakes are long, narrow, sometimes winding like Ullswater, or slightly curved in outline like Wastwater and Haweswater. The most characteristic lie in long narrow valleys with steeply sloping sides, and the slopes are continued under water with almost equal steepness, in some cases with greater steepness, and terminate in a nearly flat floor. The typical form of this class of lake is thus a steep-sided flat-bottomed trough, diversified along the slopes by the still steeper conical mounds of *débris* thrown down at the mouths of streams. Yet, while conforming to these types, each lake presents a certain individuality which distinguishes it from every other.

On a map of the Lake District on which the boundaries of the drainage areas are marked (see Map I.), the position of the lake with regard to the region dipping in towards it is somewhat remarkable. Thirlmere, Buttermere, and Crummock Water are fairly symmetrically situated in the centre of their drainage areas. Haweswater is much nearer the right than the left-hand side of its tributary area, looking down the lake. On the other hand, in the case of Windermere, Coniston Water, Wastwater, Ennerdale, Derwentwater, Bassenthwaite, and less clearly in Ullswater, the lake lies close to the watershed which bounds it on the left side. This shows a shorter land-slope and smaller drainage on the left than on

the right, and it is interesting to notice that the axis of maximum depth almost always follows exactly the same plan lying near the left bank in almost all the lakes of the last group, and running almost along the centre of Buttermere and Crummock.

Mr. Heawood makes the following observations on the results of the work in which he was my colleague, and of the harder parts of which he did more than his share.

"One point on which I should like to touch very briefly is the position of the deepest basins relatively to the general form of the valleys in which the lakes occur. In the case of lakes dammed back, whether by landslips or glacial deposits, we should expect to find a gradual deepening from above downwards in accord with the slope of the valley. Now, in their present condition, at any rate, this is not the case at all with the English lakes. Considering Derwentwater and Bassenthwaite as properly forming a single basin, and the same with Buttermere and Crummock, I find that in four of the principal lakes the greatest depression occurs in the upper half, in three it is central or but slightly below the centre, and in one case only, that of Buttermere and Crummock, does it occur decidedly towards the lower end, but even here an important depression is found quite at the upper end. If we search for some definite rule which governs the position of the deep basins, there seems ground for the assertion that they occur in association with the highest parts of the shores, or, as I should rather put it, with the points where the high ground slopes most steeply to the water. To give only one or two instances: abreast of the deepest part of Derwentwater the 1000-feet contours on the two shores are only $1\frac{2}{3}$ mile apart; they afterwards widen out to over 3 miles, but again close in to the former distance just where the deepest part of Bassenthwaite occurs. In Buttermere and Crummock, the deepest parts respectively are just between Robinson and High Crag, and between Grasmoor and Mellbreak; and in Wastwater between the highest point of the Screes and Middle Fell, where the 1000-feet contours are only $1\frac{1}{4}$ mile apart, while at the lower, shallower end they have widened to nearly 2 miles. The reason would seem to be, not that the materials from beneath the depressions have gone to make the mountains, but that opposite the steep slopes the lakes have not been filled up by the wear and tear of the mountain sides to anything like the same extent that they have elsewhere. The fact that the shores recede, of course means that the lake receives the drainage of a larger area of country, the products of the denudation of which eventually find their way to it, and, in accord with the above-mentioned position of the deep basins, we find that hardly any important streams empty themselves into them. As to the question how far the shallowing can be due to sedimentation, although, from the very steep angles at which the deltaic material slopes into the water, it might appear that the

effect cannot reach far from the shore, we must consider that this material is simply shingle which is pushed out into the water, and that the fine matter held in suspension behaves very differently. It seems natural to suppose that even when once deposited it is not finally at rest, but that, under the combined influence of currents and gravitation, a gradual movement out into the deepest parts would take place. Gravity then ceasing to act, there would be no tendency to further shifting. If the above explanation is correct, the shallowing at the lower ends of the lakes would be a natural corollary of their radiate arrangement, which, to some extent, involves a progressive widening of the drainage areas from the centre outwards. The idea also that the original form of the valleys is best preserved in the deep basins, is borne out by the fact that it is just here that the correspondence of the slopes above and below the water is most marked.

"The fact that the lakes as a whole reach just as far and no further than the beginning of the more level country which skirts the district, is in one way merely an extension of the principle of the shallowing at their lower ends. The same fact also shows that they are not held back by anything like a dam thrown across a narrow valley, for in some cases we should have to traverse the level country for miles before reaching a point as low as the deepest parts of the lakes, in several cases considerably below sea-level."

ANCIENT TRADING CENTRES OF THE PERSIAN GULF.

I. SIRÁF.

By Captain ARTHUR W. STIFFE, R.I.M.

I THINK an account of this ancient city, which, in the tenth century, was the chief emporium of the trade with the far East, may be of interest. Its very name is now unfamiliar, the actual site was long forgotten, and it has been visited by very few persons. Dean Vincent, who has been followed by others, notably Sir W. Ouseley, supposed its site to be opposite the island of Kais, or Kis, where, however, no ruins exist. Morier refers to ruins at Tahiri (the actual site), and mentions sculptures with the Persepolitan character, which have not been found subsequently. He does not appear to have visited the place, but to have written from hearsay. Captain Brucks, I.N., the first surveyor of the Persian Gulf, calls them the ruins of a "Portuguese town." The first person who identified the site appears to have been Captain Kempthorne, I.N., who visited Tahiri in 1835, and gave an account of what he had been able to see, during a visit of a few hours, in the Bombay Geographical Society's *Proceedings* of 1856. It was next visited by Commodore Ethersey, also of the I.N., about 1855 or 1856, but he published no account of his visit. His notes on his discoveries are in my possession. It was next visited by Captain

Constable, I.N., and me, in the surveying brig *Euphrates*, on October 17 and 18, 1857, and the following description is compiled from the notes then made by us. We visited the whole of the ruins, as far as time would permit. Since that time it has, so far as I am aware, been only visited once, by the telegraph-ship, on which occasion one of the tombstones was brought away, and is now in the British Museum. A similar one, brought by Kempthorne, is in the Bombay Asiatic Society's Museum.

The modern village of Tahiri is a small village inhabited by fishermen, chiefly pearl-fishers, of Arab descent, 200 to 300 in number. It is an insignificant place, and has a small square fort on a little hill at the west end, which is in lat. 27° 39′ 36″ N., long. 52° 20′ 40″ E., standing on the shore of the Persian Gulf, at the foot of a range of mountains rising to a height of near 5000 feet, and running parallel to the coast. This range appears to form a great anticlinal ridge, and is composed of limestone with much gypsum. Between these and the sea is a lower ridge, from 500 to 600 feet high, of more recent strata which dip to seaward and end abruptly inland in a precipitous escarpment, having been apparently disturbed and broken through when the great range was upheaved. It is on the slopes of this lower range, which rise up from the coast, that the ruins are situated. This coast ridge has also been broken through by transverse precipitous ravines, due apparently to torrents from the high mountains, aided perhaps by fracture of the strata. These ravines are the passes into the interior, and two of them, at least, have been fortified by walls and towers, the remains of which are still to be seen. Farther up in the mountains some of these passes have to be climbed by the aid of ropes. The situation is thus very picturesque; small patches of cultivation and date plantations are scattered about the lower ground, but the great mountains are rugged and precipitous, and appear, from a distance, quite destitute of vegetation. On a nearer approach many shrubs and plants are seen scattered over their surface, especially in the watercourses, where they often grow thickly. The present inhabitants know nothing of the history of the ruins, and could not be persuaded we had not come to dig for and take away treasure.

The ruins of the old city of Siráf lie to the west of the village, and extend for perhaps two miles along the shore. They are mere heaps of rough masonry; foundations *in situ* are to be seen, especially where cut through by water-courses, or exposed by the action of the sea, for the ruins extend from the water's edge far up the slope of the foothills. The watercourses through the city have been walled in, where required. Among the *débris* are numerous ruined water-cisterns, constructed in the style still prevailing in the country—oblong chambers excavated in the ground, lined with cement or gypsum, and arched over to prevent evaporation. The arched coverings have mostly fallen in, and the cisterns are more or less choked up. There are also many wells among the heaps of

débris. The whole extent of the ruins is strewed with broken pottery, including many fragments of Chinese porcelain.

The only building standing at the time of our visits was a large mosque of well-cut stone, in a ruinous condition, the roof or dome having fallen in. It appears to have been a handsome building, with pointed windows and doors, and it stands on the low hills near the sea. Under the building is a large chamber or cellar, now tenanted by crowds of bats.

Close to the mosque is one of the kanáts, or underground water-conduits, so common in Persia from time immemorial up to the present day. The shafts of this one are circular, about 4 feet in diameter, and 20 feet deep, distance apart about 50 yards. There was no water in it.

There are also many monolith tombstones or grave-covers of arched form, with Cufic inscriptions; they are in good preservation, and many are ornamented with carved nobs, borders, and flowers. I learn the date on the one in the British Museum, already referred to, is equivalent to A.D. 991.

These are the principal remains of the Mohammedan city. The following, I suggest, are referable to pre-Mohammedan times; they lie inland of the part described above. The precipitous faces of the ravines leading through the foothills are studded with excavated chambers, no doubt tombs, mostly so high up as to be inaccessible without ladders, but some of the lower ones could be got at by climbing. The entrances are small, about 3 feet by 2, but they widen out inside often into two or more chambers, so that one cave could be used for several bodies. Those we entered contained much fine dust and crumbling human bones; they had been cemented inside.

The most curious and interesting of the old remains are on the slope of the hillside after passing through the fortified ravine or first pass; the sketch attached gives an idea of the appearance of this part. It shows the hillside divided by a great cleft or ravine. The whole hillside appears to have been denuded for about half a mile square of the upper stratum of sandstone, leaving pillars *in situ* here and there (like the "deadmen" of modern excavating work), which show the thickness of the layer which has been removed. The sketch shows two of these pillars; the dimensions of the largest are 9 by 6 feet, and 12 to 14 feet high. On each side of the ravine a flight of low broad steps has been cut in the rock, rendering the ascent easy; and the hillside is honeycombed with troughs, either sepulchral, or in which the dead were exposed before burial. They vary from 9 to 2 feet in length, by 1½ to 2 feet wide, and 1 to 3 feet deep, and lie close together, divided only by a thin partition of rock. No traces of any covers were found, but some of them had a small ledge left all round a few inches below the top, as if to support a lid. This rock is a coarse conglomerate. The sketch gives an idea of their arrangement and of the steps; the figures

give a rough scale. The largest pillar, in the foreground of the sketch, contained a chamber cut in the rock, evidently a tomb, the entrance about 2 feet square, giving access to a rectangular chamber about 7 by 4 feet. On the top of this pillar were some remains of masonry. There are many wells on this hillside, those higher up the hill being deepest. We sounded one of these, which was 204 feet deep, with 36 feet of good water. They are from 2 to 3 feet in diameter, and some are oblong, about $1\frac{1}{2}$ by 3 feet. They are smoothly cut, and I noticed notches cut inside, apparently for footholds, to enable a descent to be made. Some had a low parapet wall on the uphill side, to prevent soil being washed into

ROCK PILLARS AND TOMBS, SIRÁF.

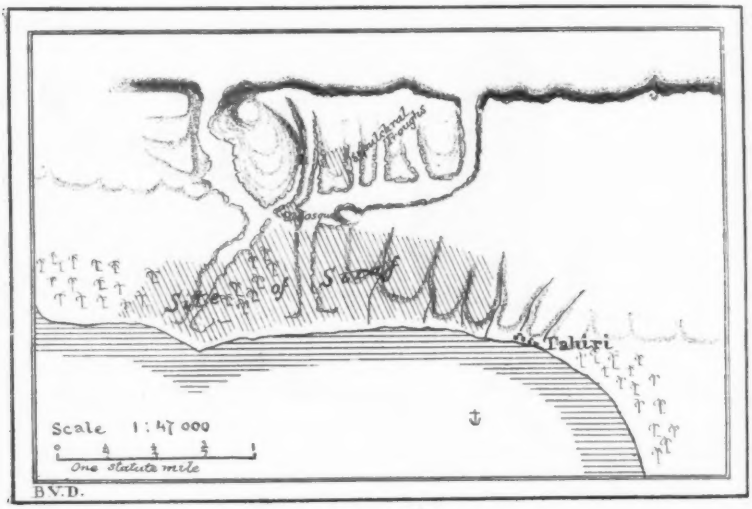
them. This wall is not built, but some of the upper stratum of rock has been left in the required position, and cut into shape at the time the rock was removed. No inscriptions or other remains were found in this part.

The little plan shows the site of the ruins and the modern village.

I will now add the little I have been able to trace of the history and trade of this wonderful place. In the 'Bibliotheque Orientale' it is stated that Siráf was founded by "Caicaous" of the Caianian dynasty, supposed to be cotemporary with David. The first account of the place I have found, is in the fragment of two Mohammedan travellers of 851 and 867 A.D.* (The misprints and mistakes of names in the English translation of 1733 are numerous.) In this it is referred to as

* Translated by E. Renaudot in 1718, from an incomplete manuscript written in 1173.

a long-established centre of traffic, and I propose to quote the account at some length, although it has been often commented on. The first of the two, Soleyman, was a traveller by sea and land, and by internal evidence, such as some of the habits of the Chinese—the wine made from rice, etc.—had probably visited the places he describes, and was an intelligent observer. He notes, for instance, *inter alia*, the connection of the tides with the moon. The distances he gives in the gulf are fairly accurate, as from Siráf to Basrah,* "whence the goods come that are shipped at Siráf," 120 leagues, and to Maskat as about 200. Taking a league as 3 statute miles, the distances are really about 118 and 188 respectively. He describes the voyage to China. On the voyage from



SITE OF SIRÁF.

Siráf to Maskat, he mentions, on the east coast of the sea, a place called Nafif Bani al Safak, which I cannot identify, and an island called Ebn Kahowan, an old name for that now known as Kishm. He then says, "In this sea are two rocks called Oman, and a narrow strait called Dordur, between two rocks, through which ships often venture to pass, but the China ships dare not. There are also two rocks, called Kossir and Howair, which scarce appear above the water's edge." These names I do not recognize, but the description refers to the islets off Cape Musandam, and the strait there known as the Fakk-al-Asad. They then come to a place called Shihr Sahar Oman, evidently Sohar, in the country of Oman, formerly an important place, and thence to

* Basrah was built about 636 A.D.

Maskat. This place he correctly describes as in the "extremity of the province of Oman," and says "the ships take in water there, which is drawn up from wells, and are here also supplied with cattle." This would do for a description of the present day: the small cattle of Oman are celebrated. From Maskat the ships stood apparently straight for India, across the sea, first touching at Kulam-Malay (this name is misprinted in 'Kerr's Collection'), evidently Quilon, "which is a month's sail from Maskat with a fair wind;" and thence proceed to China, where the Siráf merchants had been long established, as it is not spoken of as a new route. I do not follow the route beyond Maskat, but it is an interesting question whether they were provided with the compass, or merely guided by the direction of the monsoon winds and by the stars.

The second "Mohammedan," Abu Zeid, or Sayyid (either 867 or 877), is a commentator on the first; he appears to have been a merchant living at Siráf. He states that Siráf traded with the Red Sea also, and that the ships did not go further than Jedda, "whence their cargo is transferred to Cairo by ships of Kolzum, where the sea ends." Kolzum would appear to be Suez, as he continues, "The sea at this place is divided by a strip of land, which God hath fixed as a line of separation between the two seas."

Ebn Haukal, called al Istakhri, who wrote in the first half of the tenth century A.D.,* gives an account of the place. He says it is one of the greatest cities of Fars, well peopled, and about as large as Shiraz, from which place it is distant 60 farsang (about 200 miles). "Siráf has three oratories; here are wealthy merchants, who expend 30,000 dinars [about £12,000] on their houses. There are not any trees immediately about Siráf, the climate is warmer than any of those other towns (in Fars). Fruits and water are afforded by a mountain on the east of the city called Jem." (While at Tahiri we were told that supplies are still brought from a place beyond the mountains called Jem.) "It is so lofty that the air on its summit becomes like the climate of the cold region (Sardsir). In its valleys are found stones like a ruby, but liable to changes of colour. The people of Siráf devote their whole time to commerce and merchandize. I saw myself at this place persons who possessed four thousand thousand dinars [say £1,500,000], and there were some who had more, and their clothes were like those of hired labourers. A merchant of Siráf had passed forty years at sea, never leaving his ship during that time (!). At Siráf they abound in marine productions and commodities brought by sea, such as aloes, ambergris, camphin, pearls, canes, ivory and ebony, pepper, sandal; and various kinds of drugs and medicines are sent from that place to all quarters of the world. The houses are built of teak-wood or wood from Zanguebar, and of several stories."

* 'The Oriental Geography of Ebn Haukal.' By Sir W. Ouseley. 1812.

Yakút (al Rúmi), whose book was written in A.D. 1218,* visited Siráf, which had then declined, and says that it was formerly the port of the merchants coming from India, and that they call it Shila. This latter name is now that of a village about 4 miles to westward of Tahiri, and is obviously a modification of the old name. He saw at Siráf "remains of remarkable edifices and a fine mosque," and says, "it lies in the hollow of a high mountain, has no port, and vessels have to go to a place called Nabed, two farsakhs distant." This is doubtless Naband, about 17 miles to the eastward, where there are also some ruins, which were not visited by us. He then quotes Abu Sayyid, the "second Mohammedan," and observes, "Such it may have been in his lifetime, but since the isle of Kais has been colonized, Siráf has fallen from its ancient splendour." He then quotes al Istakhri, the author last referred to, almost verbatim, and concludes, "It is difficult to admit as true the description of this author, but God knows the truth." This last remark implies polite disbelief on his part, and it is strange that in less than two centuries the place had so decayed that its history and greatness were alike forgotten and discredited. As he visited the place himself, we may accept his account.

Abulfeda† (1274–1331) places Siráf on the coast between Jannabah (Ganáwah) and Najiram (? Gerun, the old name of Hormuz Island), and quotes the account of Ibn Haukal, apparently as if it referred to a state of things then existing, instead of to a long-past period. He does not give it as a quotation, but the statement in his account of the "merchant spending 30,000 dinars on a house" seems to point clearly to that source. He does not say he was ever there, and I mention his account only to discredit it.

Ibn Batúta‡ (1325–54) visited Kais, which he confuses with Siráf, and gives no account of the latter place. He describes correctly the pearl fishery as carried on now, but states that there are some who remain under water one or two *hours*, which one may charitably hope is a slip of the pen for *minutes*. Further on I hazard a conjecture as to the reason of the mistake. The above are the only references I have found to this once flourishing place. Sir William Ouseley says Siráf§ decayed after the close of the Dilamite Government, at which time Keish (Kais) became predominant. This would fix the middle of the eleventh century as the date of its decline. There is a curious legend about the island of Kais, which I hope to deal with in the history of that island; but it appears to me very probable that, in the civil wars after the close of that dynasty, under the Siljuks, or still more possibly

* 'Dictionnaire geogr. de la Perse.' By C. Barbier de Meynard. Paris: 1861. (From Yaqout.)

† 'Geogr. d'Abulfeda,' traduit par M. Reinaud. Paris: 1848.

‡ 'Voyages d'Ibn Batoutah.' Translated by C. Defrémery. Paris: 1853.

§ 'Travels, etc., in 1810-12.' London: 1819.

at the Tartar conquest in 1202–26, which was accompanied by such widespread devastation, the inhabitants of Siráf may have been driven to abandon their city *en masse*, and establish themselves on the island for safety, which would account for the rapid rise of that island to importance, and perhaps for Ibn Batúta's account.*

There appears no doubt that from the remotest date they traded with Zanzibar, the Red Sea, India, and even China. Cosmas (530-550 A.D.) mentions an ambassador from the Persian king arriving at Ceylon in a ship from Persia. As regards the "ships" used in those distant voyages, I gather from various references that the planks were fastened with coir, no nails being used, a practice still common with small vessels in the Gulf. They carried one large lateen sail as in the present day, and were only partially decked. Colonel Yule, from the Chinese annals of the seventh and eighth centuries, says that the Chinese ships then came as far as Siráf and the river Euphrates, where they lay at Hira, near Kufa, a long way above the place where Basrah now stands; also that this trade fell off about 878 A.D., owing to dreadful civil wars in China.

THE SOURCES OF THE EUPHRATES.

By WILLIAM FRANCIS AINSWORTH, F.S.A.

It has been hitherto accepted, as an established fact in geography, that the main trunk of the river Euphrates is formed by the confluence of two rivers, to both of which the name of Frat has been occasionally applied, but which are more generally known—the westerly one as the Kara Su, or Blackwater; the easterly as the Murad Su; and the latter, having a longer course than the Kara Su, has also been hitherto looked upon as the most remote tributary, and therefore as comprising the sources of the great river.

But if it could be shown that a second and lesser Kara Su, or Blackwater, and a tributary to the Murad Su, having its origin from a crater-fountain at Nur-shīn, and that that fountain is the outlet of Lake Van, it would establish that the more remote tributaries to that lake would constitute the true sources of the Euphrates.

These tributaries have their sources in the Dumanlu and Tendurek Taghs, and although it is difficult to determine, even with the assistance of Captain Maunsell's admirable map, which of the several tributaries

* Such migrations are on record, as when the inhabitants of Hormuz, the city on the mainland, abandoned their city, and migrated to the island afterwards called by the same name. This happened in the beginning of the fourteenth century, and was owing to the ravages of the Tartars. In 1859 the large town of Kongún, on the Persian coast, was abandoned by the chief and all the people, who took refuge on the island of Shaikh Shoaib, in consequence of a feud with the Deshti chief. The town on the mainland remained deserted for some years.

is the most remote, still it is quite certain that they are all, especially the river Koshab, further removed than any tributaries to the Murad Su, having their sources in the Shahrian Tagh, the Ala Tagh, and the Supan or Sipan Tagh, and that they (or one of them) constitute the true sources of the Euphrates.

The peculiar character of the artesian and crater-fountain of Nur-shin, situate at the foot of the Nimrud Tagh, and in a valley between the volcanic group of hills so called and the Antogh Tagh, constituting part of the Niphates or snow mountains of the ancients, and only separated from Lake Van by a distance of a few miles of plain and hills, the latter known as the Tacht Ali, or "The Throne of Ali," with a difference of elevation, as proximately determined by boiling-point thermometer, of from 800 to 1000 feet, is highly in favour of the conjecture that it constitutes the outlet to the waters of Lake Van, as well as the source of the lesser Kara Su.

It is scarcely probable, or indeed possible, that in such a climate, with an elevation, by boiling-point thermometer, of some 5400 feet above the level of the sea (Dr. Dickson, who accompanied Mr. Consul Brandt in his exploration of this district, gives as the result of barometrical observation, 5469 feet), the evaporation of so great a mass of water, constantly fed by numerous tributaries, some of which, as the Koshab coming from Bash-Kalah (7900 feet elevation), assume the character of rivers, would suffice to carry off the surplus waters and maintain the lake at its present level, yet if we do not admit the Nur-shin crater-spring to constitute its outlet, it would have none other as far as is yet known.

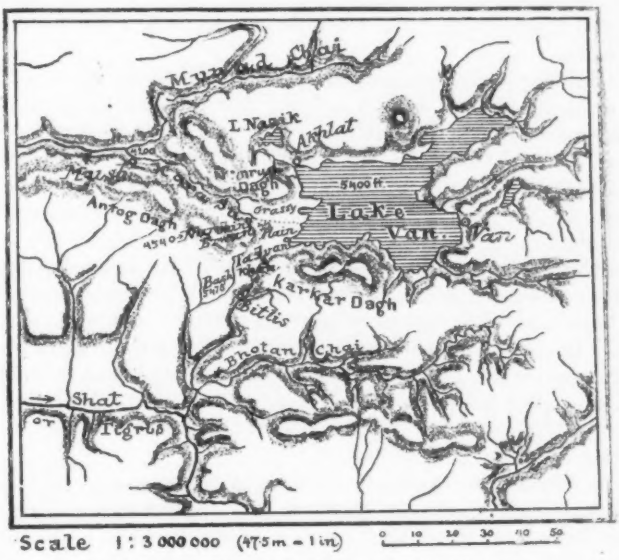
M. Ch. Maunoir, the learned Secretary to the Geographical Society of Paris, observes, in his *Rapport sur les Travaux de la Société, etc.*, for 1893, that whilst the point of separation of the waters tributary to Lake Van and to the river Tigris is not *fortement accusé*, or very clearly defined, and that the probable point of anterior or olden communication between the two basins is not easily determined, still admits that Captain Maunsell's idea, that such communication was intercepted by an overflow of ancient lava poured forth from the flanks of the Nimrud Tagh, can alone explain the present state of things.

This explanation will, indeed, alone account for a host of peculiarities which have not as yet obtained the attention which they deserve. Such an overflow would not only have separated the original sources of the Tigris from the tributaries to Lake Van, but it would also have given birth to Lake Van itself—at all events in part—constituting it, as it at present stands, one vast lacustrine crater.

It has left the southern portions of the lake restrained by a band of volcanic rock which rises at times into hilly ranges, as the Ardost and Karkah Taghs, whilst the tributaries to the river Tigris flow from the very lips of the protecting wall of rock.

To the south-west the Bitlis Chai, a tributary to the Tigris, flowing from beyond the town which gives to it its name, has its origin, as a mere rivulet (not to be admitted as a possible outlet of the lake, being at the same or even a superior elevation than the lake itself), at Bash-Khan, a handsome Kirwan-Serai, solidly constructed of black lava. The traveller is always on the ascent from Bitlis to Bash-Khan, while all beyond is more or less level plain to Tadwan and the lake.

The Easterns are by no means insensible to these great features of physical geography, and as we have Bash-Kalah, or "The Castle at the Head of the Waters," at the point of separation of the tributaries to Lake



HYDROGRAPHY OF THE NEIGHBOURHOOD OF LAKE VAN.

Van on the one side, and to those of the greater Zab on the other, so we have a Bash-Khan at the head of the Bitlis Chai.

Lake Van, thus separated by an overflow of lava from the tributaries to the Tigris, would, by the very force of circumstances arising from the contour of the adjacent country, seek an outlet in the valley of the Kara Su, only that, owing to peculiarities not uncommon in limestone districts as well as in those of igneous origin, the communication would at its outset partake of a subterranean character.

The crater-fountain of Nur-shin, which I first stumbled upon in 1840, must, from the abundance of its waters, have a more or less distant origin, and all the circumstances of the case point to that supply being derived from Lake Van. The waters pour out from a deep circular

basin of volcanic rocks, 220 feet in circumference, in two abundant streams, over the opposite lips of the crater, each stream being about 30 feet in width, and both uniting at a short distance to constitute the Kara Su. The fountain stands, by boiling-point thermometer, 4540 feet above the level of the sea, while the great plain of Mush, watered by the Kara Su and the Murad Su, averages an elevation of some 4200 feet.

It is curious that Mr. Consul Brandt and Dr. Dickson, who must have passed close to this spring, had not their attention called to it. The American missionary—the Rev. Mr. Southgate—who also travelled this road, makes mention, however, of the tradition of a fountain of unknown depth, said to exist on the summit of the Nimrud Tagh, probably a misinterpretation of what the natives said of the fountain in question.

Saint Martin, the historian of Armenia, also notices this fountain on the authority of older writers, as being near the Nimrud Tagh, and as "very remarkable." It is quite possible that the conjecture as to its being the outlet of Lake Van might meet with corroboration from researches made in the ancient annals and chronicles of Armenia. Its very name, Nur-shin, seems to be expressive of waters that here come to "light."

Add to this, that the existence of ruins of Armenian habitations, tombs, and other edifices, in the immediate neighbourhood, attest to the importance and even sanctity of the spot, and that up to a recent date. One of these edifices—a sepulchral chapel—presents a very pretty appearance, having a semicircular dome and arched windows, with a bevelled basement of black lava, while the dome is of red lava. The crumbling ruins of an old castle are likewise to be seen on the adjacent heights.

The only doubts which I can see might be opposed to the conclusions here arrived at are—May not this crater-fountain derive its waters from the Nimrud Tagh itself—a group of conical peaks having no less than six distinct and lofty pinnacles rising above the valley of the Kara Su?

But the trend of the Nimrud Tagh does not lie towards the valley of the Kara Su, but with the Belishan Tagh towards the valley of Akhlat, which contributes several tributaries to Lake Van. The Belishan Tagh sends off tributaries to the upper Murad Su and to the Kara Su, whilst the mountain tarns of Nasik and of Kamp belong, the first to Lake Van and the second to the upper Murad Su. A glance at Captain Maunsell's map, although it ignores the Tacht Ali, Nur-shin and its fountain, and the Kurd village of Kotni, sufficiently indicates the independence of the Kara Su from the easterly mountain groups, although deriving tributary waters from the Antogh Tagh, or westerly groups.

Such are the relative positions of Lake Van and the valley of the

Kara Su, that it might well be conceived that before the waters of the lake were dammed up by the overflow of lava, of which the Tacht Ali constitutes the culminating point, the natural course of these rivers of Van would have been by the valley of the Kara Su; and what can be more probable than that, after the epoch of the overflow, or at the very time of that overflow, they were able to maintain their old course, only by a subterranean channel?

Another objection might be suggested inasmuch as the amount of water, although very considerable, scarcely equals what might be expected from the outpour of so vast a lake as that of Van. But to this latter objection it may be opposed that no outlet save this is at present known.

It is, however, by no means certain that some of the tributaries to the river Tigris, so carefully delineated in Captain Maunsell's map as having their origin close to the southerly and outer crust or lip of the basin of Lake Van, may not be derived from the percolation of the waters of the lake through the said outer crust, just as is opined of the Nūr-shīn crater-fountain in an opposite direction.

This, however, remains a question for further minute topographical investigation, and, should such be the case, Lake Van would have (and examples of such are well known) outlets for its surplus waters, to the Euphrates on the one side, and to the Tigris on the other.

THE GEOGRAPHY OF PERSIA.*

By SIR FREDERIC J. GOLDSMID, K.C.S.I., C.B.

By direction of the French Minister of Public Instruction and Fine Arts, M. J. de Morgan left Paris for Tehran in September, 1889, on a scientific mission, the nature of which will be understood from the classification of its results under the four heads of (1) Geographical, (2) Linguistic and Ethnographical, (3) Archæological, (4) Geological and Palæontological. Accompanied by his wife and an old soldier-servant, he reached the Shah's capital by the well-known route of Baku, Resht, and Kazvin. There, by aid of the French Legation, he was enabled to organize his camp and make all necessary arrangements for the contemplated exploration; and, late in November, he broke ground in the direction of the Lár valley. The mission, after a halt of some days at Rehna, near the foot of Demavend, found its way to Amol, a town of varied fortunes, and thence into the lower plains of Mazanderan, amid marshes and streams. From Amol its course was an easterly one, and, visiting Barfarush, Sari, and Ashraf, it arrived at Asterabad, where it

* 'Mission Scientifique en Perse,' par J. de Morgan. Tome premier. Études Géographiques. Paris: E. Leroux, 1894.

met with a kind reception from the governor and other residents. After a month's exploration in these parts, it returned westward along the shores of the Caspian—on the right of the Shah Abbas causeway—to Gilan, having taken occasion to visit Ferahabad, the favourite residence of the great Abbas, Mashhad-i-Sar, Aliabad, and the district of Tunekabun, of which the "Khorremabad" of Mr. Curzon's map is an interesting village. Crossing the Kizil Uzun in a boat, the explorers arrived for the second time at Resht, and then proceeded from that place into the Russian Talish, by Astara and Lenkoran. Two months were passed in exploring the mountainous country inland of these roadsteads, one of the main objects of research being the local burial grounds, an inspection of the several examples of which resulted in the discovery of no fewer than 220 tombs. But the action of the Russian Government put a stop to this process of archæological investigation; and, the return of the mission to Lenkoran, and interchange of telegrams with the French Embassy at St. Petersburg having failed to effect a renewal of operations, a move was decided upon to the Little Caucasus. Early in July, then, the small party of explorers, passing up the whole length of Lenkoran, entered the plain of Moghan at Balasui-var, and reached the Araxes at Karadui. Thence crossing the river, they moved among the mountains to Shusha, from which point they turned south to Tabriz, recrossing the Araxes by the Khudafrin bridge, and following the road through the Karadagh, west of Ahar.

For the "Geography" of the book under notice, the journey above sketched out may be held to include the main work of M. de Morgan's *Mission scientifique*, because the shores of the Caspian and contiguous provinces occupy the lion's share of the ground he has described. With respect to the time taken up in accomplishing the objects proposed, it certainly represents the larger half, though we may roughly estimate a full year in 1889–90 for the one, and a full year in 1890–91 for the other division. In making a fresh start from Tabriz, a valuable addition to the staff of the mission was found in the person of Colonel Abdi Tataos Khan, a young artillery officer of eight and twenty, who spoke equally well English, French, Turkish, Persian, and Armenian. The grant of his services was but one of many acts of courtesy, on the part of the higher authorities, which M. de Morgan experienced in Azerbaijan, and which he now gratefully acknowledges. "Reçus de la façon la plus gracieuse par S. A. I. le prince Héritier, S. A. l'Emir Nizam, alors Gouverneur-Général de l'Azerbeidjan, par S. E. Nousseret-ed-Dôlet, actuellement Gouverneur à Tauris," are his words, and again, "nous avons passé à Tauris quelques jours charmants." It need scarcely be added that the French minister at Tehran and his coadjutor the French consul-general at Tabriz had something to do with bringing about this partly moral but wholly substantial support.

The party now proceeded in a southerly direction by Maragha, and,

east of the Urmiya, or Urmi lake, to Miandoab, where the Kurdish population is said to begin. Though well treated at Suj Bulak and in the Mukri * district, where a comparatively civilized chief named Saifu'd-din exercised rule, the rougher side of the Kurdish character was manifested towards them further on, at Sakiz and Bana. These two districts, which form part of the province of Sehna, contain a population of whom many are hostile to strangers. M. de Morgan, in active search of Assyrian inscriptions, the existence of which had been indicated by Sir H. Rawlinson, penetrated the valley of Kelvi (or Lesser Zab) to Sardasht, a mountain village; but the difficulties foreshadowed in an attempt to carry on his work satisfactorily among Turkish Kurds caused him eventually to modify his original intention of attaining the right bank of the Tigris at Mosul, and to prefer passing south into Luristan, thus remaining under the ægis of Franco-Persian protection. Retracing his steps to Mukri, he took advantage of the hospitality of Saifu'd-din to locate Madame de Morgan in that chief's stronghold at Sardárabad, and himself posted back to Tabriz, there to mature and discuss his modified plans in the society of influential advisers. Having rejoined his lady on the completion of his arrangements, M. de Morgan left Sardarabad on November 20. Space would fail us to follow the mission, step by step, through the remainder of its progress. Suffice it to say, it had many troubles to encounter, at one time owing to severe snowstorms which occasioned serious loss of life, and general inclemency of the climate; at another, from the rough treatment of the natives, as at Hamadan and Asadabad. Among the places visited may be named Burujird, Ushtara Kuh; the post-road stations between Hamadan and Baghdad; Shuster, Dizful, Ahwaz, Mohammerah, Bushire. On December 1, 1891, the mission had returned to Paris.

Judging from the section of "Geography," the whole work should form a notable addition to the bibliography of Persia. Its letterpress and illustrations are worthy of Leroux, though a few of the photographs are somewhat uneven in execution. The volume now before us includes a preface and ten main divisions; one of these, "Les Rives Méridionales de la Mer Caspienne, entre l'Atrek et l'Araxe," is subdivided under six minor heads. There is also attached a very useful "Répertoire des Noms Géographiques," which gives the names of places both in the Persian and Roman character.

In conclusion, we would add that the greater the number of ministers of instruction and the fine arts that can be found, throughout the civilized world, ready to despatch scientific missions into lands possessing material for intelligent exploration, the better for the army of readers who profit from their results. The three new maps, the production of which is due to M. de Morgan's labours, are those of—

* Curzon and Thielmann call it Mikri.

1. The Southern Shores of the Caspian, including Asterabad, Mazanderân, Gilan, and the Talish.
2. Mukri Kurdistan.
3. Elam.

MR. CLEMENT LEY'S WORK ON CLOUDS.*

By H. N. DICKSON, F.R.S.E.

At a time when the burning question amongst meteorologists is that of cloud classification and cloud nomenclature, it is specially satisfactory to have a complete summing up and judgment from one who has devoted the greater part of his life to a study of this subject, and who has long enjoyed a European reputation as a skilled observer of clouds. Innumerable as have been the improvements and modifications proposed from time to time on Howard's original nomenclature, these have hitherto consisted almost entirely of subdivisions of Howard's three great classes—the cirrus, the stratus, and the cumulus; and the divisions into intermediate forms have been for the most part quite arbitrary, limited in number by the observer's supposed powers of discrimination. Mr. Ley takes advantage of our increased knowledge of the mechanism of atmospheric currents, and his book is an attempt to classify the results of his lifelong observation according to the different conditions which we now know give rise to the formation of clouds. Utilizing Helmholtz's deductions as to the wave surface of a current of air produced by another current of air flowing over it, Mr. Ley includes all the stratiform clouds under the term "Clouds of Interfret." Cumuliform clouds come under the heading "Clouds of Inversion," their formation being ascribed to condensation in ascending currents; and the luminous and cirriform clouds, formed of falling particles which tend to "lag" as they enter lower and more slowly moving strata, are termed "Clouds of Inclination." Under these three types are included all the observed forms, except ground-fogs and haze, which are called "clouds of radiation," and the greater part of the book is devoted to a description of the species occurring under each head as a consequence of special conditions modifying the processes of interfret, inversion, or inclination. Seventeen species are considered sufficient to cover the most frequent cases, and the classification is completed by nine more specialized forms. Although the number of different kinds is considerable, the method at once commends itself as enabling the observer to connect each cloud-picture with distinct physical processes going on in the atmosphere.

In the latter part of the work the author discusses the general

* 'Cloudland: A Study on the Structure and Characters of Clouds.' By the Rev. W. Clement Lay. London: E. Stanford, 1894.

circulation of the atmosphere as deduced by Ferrel from theoretical considerations, and compares the prevailing cloud-forms observed in different parts of the globe with those which would be produced, according to Mr. Ley's views, if Ferrel's circulation be correct. A chapter on the clouds of cyclones and anticyclones is practically a restatement of the author's celebrated investigations on the currents in these systems, but we note that Mr. Ley accepts the hypothesis that the ascending currents in cyclones originate through local heating at the Earth's surface, no explanation being given of Hann's conclusions as to the occurrence of cyclones where such conditions do not exist.

THE SOUTHERN URALS:* RESULTS OF RECENT JOURNEYS.

By Dr. FUTTERER.

THE opening of the new railway will mark the first stage of development of a district which, thanks to its extensive forests, abundant minerals, and unlimited water supply, bids fair to become one of the most important of the Russian Empire in Asia. Engineers and forestry experts from Western Europe, brought in contact with the work of the foundries and smelting-works, have elicited the apparently paradoxical fact that the population of many of the mining and smelting districts in the Urals stands on a higher level of civilization than is found in regions west of the Volga. The central and southern Urals are easily accessible. The large saloon steamers on the Volga cover the distance from Nishni Novgorod to Samara in a little over forty hours; and Samara is the starting-point of the Siberian Railway. From Samara the central Urals are reached by steamer on the Kama river to Perm, and thence by rail to Tjumen. The two trans-Ural railways are to be united by a north and south line. From Samara the Siberian Railway runs *viâ* Ufa, Slatoust, and Miess to Chelyabinsk; and in September last the extension to Omsk was completed. To the east of Ufa the line rises gradually over successive plateaus to a great height, and the country only assumes a mountainous character between Slatoust and Miess in the Furesan basin, where the descent into Siberia has already begun. Deep cuttings, high bridges, and long stretches of steep rock-faces, showing marks of blasting, lead with many windings through the mountains, recalling the southern Black Forest Railway. Only tunnels are absent; these have been everywhere avoided, even at the expense of very deep cuttings, to prevent possible interruptions of traffic by their collapsing. The bridges are all of iron. The speed of the trains is not great; the journey from Samara to Chelyabinsk—a distance of 524 miles—occupies thirty-six hours, an average speed of 14½ miles an hour. Stoppages of three to forty minutes are made at every station, and buffets are provided at each. On the Moscow-Samara-Siberia line there are no sleeping or restaurant cars, but in the through trains two beds can be fitted in each compartment, for which the travellers must provide blankets and pillows.

The condition of the roads is an important matter in the industrial districts. Near the great smelting-works at Belarezk much has been done during the last fifteen years, and the main roads for bringing in supplies for the furnaces are extremely good. The road between the works and the railway station at Wasovaia, however, is in a terrible state even in dry weather, chiefly because it passes through properties not owned by the foundries.

* Abstract of paper read at the Berlin Geographical Society, November 3, 1894.

In the Rundblick district, great numbers of dark parallel ranges of hills can be seen from any of the more outstanding heights, as, for example, Fremel (4900 feet), most of them to the westward, stretching from far to the north towards south-south-west. The outline of these ranges is remarkably regular, broken only here and there by a summit of unusual height. The view to the eastward is very similar. The ranges beyond, not so high as the western mountains, extend north and south as far as the eye can reach, and everywhere the undulating character is maintained; no high peaks or deep valleys disturb the peaceful aspect of the country. None of the western ranges have this uniform character so strongly marked as this so-called main chain of the Urals, and it persists even further to the north, where the same range passes more into the middle of the mountain region, whence its frequent designation of "central chain of the Urals," which is rather misleading here in the south, as the often isolated groups in the Siberian steppes can scarcely be taken as an eastern equivalent to the gigantic peaks of the west, such as Fremel, Sigalga, Maschark, etc. The real significance of the Ural Tau lies in its geological position, which makes it the watershed between Europe and Asia.

On a first glance at the map, it seems surprising that the rivers rise on the low Ural Tau and break through the high western chains, but the geology of the district shows that the former represents the oldest part of a range existing in Palæozoic times, to which the western peaks (Sigalga, Nari, etc.) were added in the Devonian period by faulting. With the mountains in a north and south line the rivers would flow east and west towards the sea, and as new parallel faults formed the river-courses would be blocked until a fresh opening was broken through the newer ranges, and the second channel would remain permanent if the erosive action of the water kept pace with the successive faulting, or if its violent outbreaks always took place at the lowest part of the mountain barrier.

The contrasts which make the landscapes of the Alps remarkable are in the Urals equalized and obliterated into monotony. The valleys are broad depressions without marked gradients, partly covered with forest, and at the lowest level with marsh or marshy woodland. No sparkling brooks unite to form the rivers, the waters take their slow and melancholy way from low-lying bogs. Looking down from a height, one sees vast stretches of forest, between which marshy waters or lakes nearly covered with vegetation reveal the birthplace of great rivers. These places are almost impenetrable; a passage can only be made in the face of great difficulties, and communication really depends on the long hard winters. The forest extends up to the line of 3600 feet, and only the highest parts of the peaks show bare rock and boulders.

The forests of the Urals are of the greatest economical importance. For decades everything depended on the supply of wood in the immediate neighbourhood of the populous districts, but in the last half-generation a change has taken place; many places are reafforested, and signs of cultivation are visible. The smelting-works now receive charcoal for fuel from the most distant regions, thanks to the establishment of widely distributed charcoal heaps and the construction of roads. Where the transport of fuel is not possible during summer, it is accomplished in winter by means of sledges. Since the forests are now no longer destroyed, but only the superfluous wood utilized, the production of fuel will be sufficient to meet a greatly increased consumption as soon as former damage is fully made good. A vigilant watch is kept on the forests to prevent harm being done; for even in the spring great conflagrations are easily caused by the camp fires of the nomad Bashkirs.

Besides fuel, the forests have to furnish material for building the vessels which carry the products of the smelting-works to the Volga, and for this large quantities

of the best timber are required. In Belarezk alone some sixty vessels are built annually, of at least twice the size of the ordinary craft for inland navigation in Germany. In spring, when the water is highest, all the vessels set out for the Kama, *viâ* Ufa, and at this season the river is entirely covered with them. After reaching the Volga below Kasan, the greater part of the flotilla goes to Nishni Novgorod. The boats themselves are sold for what they will bring, which is often scarcely the price of firewood. It is thus only possible to take away the manufactured products of the smelting-works once a year, and the production is limited in this way to some extent, for the supply of raw material could support a much greater trade. The evil could be removed by the construction of a line along the east side of the Ural Tau, a work presenting no serious difficulties.

THE MONTHLY RECORD.

THE SOCIETY.

The Sixth International Geographical Congress.—As this number is going to press the arrangements for the London meeting of the Congress are complete, and the ordinary work of the Society is practically suspended to allow of all possible attention being given to the foreign members as they arrive. The office of the Congress was removed from the house of the Royal Geographical Society, where all the preliminary organization has been carried out, on Friday, July 26, and took up the quarters in the Imperial Institute which have been hired for that purpose. Up to July 22, 1265 members' tickets had been issued, and 160 transferable tickets for ladies were also taken. The foreign members reported up to that date numbers close on 400, France, Germany, and the United States being the countries most largely represented. Nearly 200 delegates from foreign governments and geographical societies are included in these numbers. A programme of the meeting and a provisional programme of the papers to be read were issued at the beginning of July; the first List of Members was issued on July 24, followed by a second list on Saturday, July 27. A daily *Journal of the Congress* will be issued every morning at 9 a.m. from July 26 to August 3, the principal part of it being given in English, French, and German. Abstracts of all the papers to be read have been printed and distributed in advance.

The Society's Flag.—A flagstaff has been erected on the south-western angle of the roof of the Society's house, and a special flag designed by the President—a Union Jack with the Society's crest in the centre—was hoisted for the first time on the occasion of the meeting of the Sixth International Geographical Congress.

AFRICA.

The Population of West Central Africa.—In the absence of complete data for the estimation of the population of Central Africa, the figures which have been hitherto given have been necessarily based on broad generalizations from the scanty

material available, and accordingly the most diverse results have been obtained. In two different quarters attempts have lately been made, by an examination in detail of the information so far collected, to at least pave the way for a more correct estimate than has hitherto been reached, for certain portions of that continent. Restricting the field of inquiry to the Congo basin, the *Mouvement Géographique* has, during the last few months, published a series of notes, dealing with various separate districts, obtained either from the explorers themselves or from their published writings; while the problem has been attacked by Dr. A. Vierkandt, of Hamburg, in a brochure accompanied by maps. In this, while intended primarily to relate only to the Bantu negroes of West Central Africa, the Sudan negroes have been subsequently included, whereby instructive comparison can be made between ethnographically distinct regions. The methods employed—both quantitative, by which direct estimates of population are formed for individual areas, and qualitative, by which conclusions are drawn from a consideration of the economic or other conditions which prevail—are briefly explained in Dr. Vierkandt's introductory remarks. He insists particularly (1) on the danger of incorrect generalizations, owing to the sudden contrasts always to be found among uncivilized races; (2) on the necessity of distinguishing the typical from the exceptional; and (3) on the liability, due to various causes, to an over-estimate of density. The results obtained from a detailed examination of the various subdivisions of the whole area, lie rather in the direction of a determination of types of settlement and relative densities, than of a direct estimate of the total population. (A supplement dealing tentatively with the latter shows results considerably lower than those of Supan.) In the Bantu region a certain regularity of distribution is to be noticed, a generally well-peopled coast zone being followed by a sparsely inhabited tract, and this again by a dense population in the far interior, while a similar symmetry is to be seen both north and south of the thinly peopled forest region. One of the most noteworthy phenomena is the tendency (closely connected with the migrations of tribes) to concentration in border-lands, whether along the coast and the courses of rivers, or along the margin of the forest. The chief factors of distribution may be divided into physical, ethnographical, and historical, examples of which are respectively, the distinction between the forest and savannah, the differences between the Sudan and Bantu negroes in point of culture, and the effects of the slave trade and of contact with European influence. As regards the types of settlement, a contrast may be drawn between those with a relatively dense, industrial population, and a more sparse one whose mode of life is determined by considerations of defence. The result of Dr. Vierkandt's study is to show that in the Bantu region dense populations are found only in restricted areas, while "dense" must always be taken as a relative term. This should be borne in mind in reading the numerous accounts of dense populations published by the *Mouvement*, which can at best, in the present state of our knowledge, cover a portion only of the whole area, and that perhaps the most thickly populated.

Expeditions in the Niger Basin.—Of the three expeditions—English, French, and German—which within the past half-year have sought to secure a footing for their respective nations in the *Hinterland* between the Volta and the Niger, an account of the first was given by Captain Lugard at the concluding meeting of the Royal Geographical Society, while in the last number of *Petermann's Mitteilungen* (1895, p. 151) an interesting letter from Lieut. von Carnap is published, giving an account of the German expedition, which, starting from the Togo-land Protectorate under the leadership of Dr. Gruner, has performed some important geographical work apart from its political objects. Proceeding by way of Salaga and Yendi, and experiencing much difficulty in the country of Mangu from want of water, the expedition traversed the kingdom of Gurma, about which

Barth collected some information in 1853, but the capital of which had never been previously visited by a European. The French expedition arrived only six days later than the German advance party under Lieut. von Carnap. After a long detention here, during which an agreement was concluded with the king, the expedition proceeded to Say, on the Niger, which is described as the hottest place visited (107° Fahr. and over in February) and a particularly undesirable residence, owing to the millions of insect pests and the pestilential atmosphere arising from the lagoons. Hence the course of the Niger was followed southwards by a part of the expedition, while as far as Girri the country on its bank was surveyed by Lieut. von Carnap. Thus the section of the river between Say and Gomba, which has for so long remained as a dotted line on our maps, has at last been explored. On the way the porters were attacked by small-pox, and it was decided in the end that Lieut. von Carnap should return with the sick by way of the river and Lagos, while Dr. Gruner and Dr. Döring, another member of the expedition, returned through Borgu. Besides a route survey and determinations of positions by the theodolite, birds and insects were collected, while ethnographical observations were made as far as possible by Lieut. von Carnap. Of the French expeditions, two of which started from Dahomey, that under Captain Decœur visited Nikki (reached by Captain Lugard), while the other under Captain Toutée (*Comptes Rendus*, Paris Geogr. Soc., 1895, p. 179) reached the Niger at Bajiebo (Gladjebo on Perthes' map, Bajibo of Lugard) in the short space of forty-nine days after leaving Kotonu. He is said to have explored the basin of the Murza and carried out a survey of the route. He throws great doubt on the supposed journey of Duncan in 1845, though it will be remembered that the fact at least of that journey seemed to be established by Dr. Wolf's explorations in 1889.

M. Clozel's Explorations between the Congo and the Shari.—This explorer, who has lately returned to Paris from an expedition up the Sangha river, which set out early last year, has explored some new ground on the watershed between the Congo and the Shari basins. The *Mouvement Géographique* (1895 No. 14) gives some details as to his route, which led from the Upper Sangha, through the unexplored tract lying between the routes of Mizon and Maistre (both traversed in 1892). After crossing the Mambere, one of the upper branches of the Sangha, on which he had founded the station of Tendira in about 5° N., M. Clozel first reached the village of Budul, chief of the important Bubara tribe, and eleven days later reached the water-parting at an altitude of about 2300 feet. North of this he came upon an important stream named Wom, which he considered to be the upper course of the Logone. After following its course for about 20 miles, the expedition retraced its steps, returning to Tendira, and thence to France.

M. Foureau in the Sahara.—This energetic explorer is still persevering in his attempt to open up a route to the south by way of Aïr. In a letter addressed to the Paris Geographical Society from Biskra on April 14 last, he announced that he purposed on the morrow to set out once more for the country of the Azjer Tuareg, and that he had good hopes of at last succeeding in his attempt. In January, 1894, he prevailed on the Azjer to agree, that on the payment by the Algerian authorities of the value of certain camels which they had lost at the hands of a raiding-party from French territory, they would escort him as far as Aïr on his journey south. He ascribes the failure of his attempt last winter to the fact that he was entrusted with a part only of the sum stipulated, the payment of the remainder being deferred until representatives of the tribe should proceed to Tuggurt to receive it. The whole sum having since been paid to these, M. Foureau is confident that the opposition of the Azjer will at once cease.

AMERICA.

The Future Capital of Brazil.—A recent number of the *Comptes Rendus* of the French Academy states that, the National Government of Brazil having decided to transfer the capital to a more favourable situation, a committee under M. Cruls, the director of the Rio observatory, was nominated for the purpose, and has now completed its work. A spot, very advantageously situated on the high plateau, has been chosen in the region of the Pyreneans, between the latitudes of 15° 40′ and 16° 8′, and between 49° 30′ and 51° W. long. Owing to the great altitude of this spot, which is over 3500 feet above the sea, one can expect a pleasant temperature similar to that of Southern France during the summer, while fever, so common in the coast region of Brazil, is not likely to be prevalent. The numerous rivers which flow in the neighbourhood are capable of supplying a population of as many as a million inhabitants with plenty of water. The only drawback is the distance from the coast, as it will take from eighteen to twenty-four hours of railway travelling to reach the capital, after a railway has been constructed from the coast. A quadrilateral space 100 miles long and 60 miles wide has been assigned for the future capital.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Earthquakes in Russia.*—This is an important contribution to the literature of earthquakes, which will take its place by the side of the catalogues of R. Mallet and A. Perry. A. Orloff, the author of several works on earthquakes published in Russia, began the compilation of this catalogue in 1869, and he had nearly terminated it when death put an end to his life-work in 1889. Professor Mushketoff has not only completed the work by compiling the lists for the years 1880–1887, but he has also revised the whole, and added to it a map of the Russian empire and the adjacent territories of Asia, which shows at a glance the geographical distribution of earthquakes, as also several diagrams showing the distribution of earthquakes during different months of the year. In an able preface, he has also summed up the conclusions which may be drawn from the catalogues, and given a translation of two chapters from Professor Milne's well-known book relative to the effects of earthquakes upon buildings. A special value has been given to the work by including in it China and the vassal territories of the Chinese empire, which are so little represented in the catalogues of R. Mallet and A. Perry. Ferck's list for China, as also M. Peschuroff's list of earthquakes in China during the years 1371 to 1644 (compiled by the Russian author from the 'History of the Min Dynasty'), and Professor Vasilieff's data for Manchuria, have been embodied in the new catalogue, as well as many most valuable data relative to Turkestan, Dzungaria, Mongolia, and parts of Asia Minor and Persia situated on the frontier of Caucasia. All these are quite new to West European literature. For European Russia, Caucasus, and Siberia all available materials have been utilized, the local annals, especially those of Eastern Siberia, having proved to be of a very great value. The catalogue contains a list of about 2400 separate earthquakes which occurred in 560 different localities, from 596 B.C. till 1887. Out of them, 710 took place in China, 549 in East Siberia, 36 in West Siberia, 202 in Central Asia, 590 in Caucasia, 121 in Asia Minor and North Persia, and 188 in European Russia. If those periods only are taken into consideration

* 'Catalogue of Earthquakes in the Russian Empire,' by I. Mushketoff and A. Orloff (being vol. xxvi. of the *Memoires* of the Russian Geographical Society for General Geography). St. Petersburg, 1893. 580 pages. With a map and several diagrams (Russian).

during which the observations went on without interruption, the frequency of earthquakes may be represented as having been 640 in each hundred years in Caucasia, 310 in China, 290 in East Siberia and Turkestan, 138 in Middle and South Russia, and 18 only in North Russia, Finland, and the Baltic provinces. As to their frequency during the different seasons of the year, the data of the catalogue show that, while in Siberia and Central Asia earthquakes are more frequent during the cold seasons (winter and autumn) than during spring and summer, the proportion is reversed for China and Caucasia, as is seen from the following table:—

NUMBER OF EARTHQUAKES.

	Spring.	Summer.	Autumn.	Winter.
China	181	239	137	123
Siberia	160	123	141	177
Central Asia	23	44	87	47
Caucasia and adjacent countries	166	188	96	209
Other regions	31	34	57	70
Total	561	628	518	626

The descriptions of separate earthquakes, especially those of the last two centuries, are particularly interesting—the more so as the volcanic eruptions which took place in Kamschatka have been described by competent observers. The earthquakes which took place in our century round Lake Baikal, on the south-west coast of the Caspian Sea, and in the Tian Shan in 1887, are so well described that some of the accounts given are in themselves very valuable monographs.

Early Magnetic Observations.—By one of those curious coincidences of discovery which have so frequently occurred in the history of science, two German investigators have found almost simultaneously the records of the earliest systematic observations of the variation of magnetic constants, and the first isoclinic magnetic map. In 1721 Professor W. Whiston, of Cambridge, published a book entitled 'The Longitude and Latitude found by the Inclinatory or Dipping Needle; wherein the laws of Magnetism are also discovered,' and this seems to have been to a large extent lost sight of, perhaps discredited by Sir Isaac Newton's personal objections to the author. References are indeed found in English memoirs to Whiston's work, and the "discoverers" of his observations in the libraries at Berlin and Göttingen have not perhaps lighted upon such a novel find as they suppose. Dr. Wilhelm Felgentraeger describes Whiston's work in a paper entitled "Die Isoklinenkarte von Whiston und die säkulare Aenderung der magnetischen Inklination im östlichen England," for a copy of which we are indebted to Professor Hermann Wagner. It reproduces the map of lines of equal dip drawn up for England by Whiston in 1721, and gives a diagram showing graphically the changes in the position of lines of equal dip at different times. Simultaneously, Mr. L. A. Bauer at Berlin had his attention drawn to the book, and published an account of it in the *Bulletin* of the Philosophical Society at Washington. He also gives a general account of Whiston's observations, with comments on Dr. Felgentraeger's paper, in *Nature* for January 24, and notes further observations with the dipping-needle at sea contained in a subsequent book by Whiston published in 1724.

Formation of Lake Basins by Wind.—Professor G. K. Gilbert records some interesting observations made in the drainage area of the Arkansas river in the *Journal of Geology* for January–February, 1895. He shows that a class of shallow lakes exists distinct from those formed in hollows of the drift or enclosed by sand-dunes. The main feature of these lakes is that they are extremely shallow; indeed, they can be waded across in every direction. They have no definite outlet or inlet, receiving water from rain, and having different degrees of permanence. The

normal slopes of the land are always sharply interrupted by the steep sides of their saucer-like depressions. Most of these lakes which have been examined are formed in shale, on which little vegetation is found, and the writer was driven to the conclusion that they were excavated by the force of the wind scouring out the disintegrated rock unprotected by vegetation, the rate of wind-erosion being no faster than the disintegration of the surface layers of the rock by weathering. The theory of origin is that when by any accident the plant-covering of an arid region is locally destroyed, the wind sweeps out the disintegrated material, and in favourable conditions a basin is produced. If this is alternately filled with water and dried up, the excavating power of the wind may have frequent opportunities of continuing to deepen the hollow. Professor Chamberlin also suggests that the shallow lakes of arid regions may be substantially deepened by cattle and other animals wading in to drink, and carrying away a quantity of mud on their legs, which is lost in the surrounding country before they return to the water.

Biological Distribution and Temperature.—Dr. C. Hart Merriam publishes in the *National Geographic Magazine* for December 29, 1894, a paper which summarizes his researches during the last twenty years on the law of the geo-geographical distribution of terrestrial animals and plants. It is a memoir of high importance in physical geography, enunciating as it does the definite terms of the control exerted by the predominant feature of environment upon living creatures. The plant and animal zones of North America are alone considered in this paper. There are three main zones of life—the *Boreal*, divided into Arctic, Hudsonian, and Canadian; the *Austral*, including the Transition, Upper Austral, and Lower Austral; and the *Tropical*. The problem which Dr. Merriam set himself to solve was to find the causes which prevented the vegetation of each zone from spreading over the neighbouring divisions. He touches lightly on his labour in testing several theories of possible climatic control, all of which were in turn found insufficient, but he arrives finally at two fundamental propositions which he finds sufficient to explain the facts. These are (1) the northward distribution of animals and plants is determined by the total quantity of heat—the sum of the effective temperatures; (2) the southward distribution of Boreal, Transition-zone, and Upper Austral species is determined by the mean temperature of the hottest part of the year. The sum of the effective heat is the constant obtained by adding together the excess of the daily temperature above 43° Fahr., which is the minimum generally accepted as that a which active plant life begins. The effective temperature begins in spring, when the daily temperature first rises above 43°, and continues to accumulate until in autumn the daily mean becomes once more lower than 43°. The paper is illustrated by a series of vegetation-zone and temperature maps of the United States. The influence of humidity was found to be of secondary importance to that of temperature in limiting the zones.

High Balloon Ascent.—The geography of the air, which, together with oceanography, claims a place beside the science of the Earth's land surface as forming part of geography, has been notably advanced by Dr. Berson, of Stassfurt, who has made successful observations at a height of 31,300 feet above the surface. The highest balloon ascent previously made was by Coxwell and Glaisher in 1862, when they succeeded in making observations up to 29,000 feet, although Mr. Glaisher believes that the balloon rose to 37,000 feet while he was unconscious. Dr. Berson, we learn from the *Tour du Monde* of March 2, has made a number of ascents in his balloon, the *Phœnix*, attaining heights of 20,000 feet, or nearly so, on four occasions. He found that at all seasons of the year the temperature at these high altitudes is practically constant, varying from −14° to −19° Fahr. On December 4, 1894, Dr. Berson started on his ascent at 10.28 a.m. alone in the car, and at noon, when

the elevation of 22,000 feet was reached, he began to feel discomfort from reduced pressure; but he had provided for this contingency by taking up with him a large steel cylinder of compressed oxygen fitted with a tube for breathing through, and thus he was able to rise without serious discomfort until the altitude of 31,300 feet, which was reached at 12.49. The sky was clear and of a pale blue; the temperature had fallen to −54° Fahr. Descending slowly, he reached the ground safely in three hours. His experience seems to show that with suitable precautions higher ascents may safely be made, and the use of compressed oxygen in mountaineering above 20,000 feet suggests itself as a possible aid to alpinists.

CORRESPONDENCE.

Sijilmásiyah and Tafilet.

Mr. Walter B. Harris, in his paper "A Journey to Tafilet," in the current number of the *Geographical Journal*, gives some very interesting particulars respecting ancient Sijilmásiyah (which he writes "Sijilmassa") and its ruins, which he visited; and he supposes that that must have been the former name by which Tafilet was known. He says (p. 334): "It is in the district of Wad Ifli that the ruins of the city of Sijilmassa are situated. . . . The place must at one time have been a very large city, though but little remains now but crumbling ruins, with a mosque and minaret in tolerable repair, and a half-ruined bridge over the Wad Ziz. . . . Although the name Sijilmassa is used, the common term for the ruins is Medinat el-Aamra. . . . The date of the founding of Sijilmassa is difficult to gather, for, probably long before the town was built, there was a Berber colony there; but the period of its destruction is better known," etc.

I have quite recently met with much information respecting this very ancient place—the name of which, as I have written it, is, in the original Arabic سجلماسيه—in writing an account of the rise of the Ubaidian, or Isma'ilian, or Fatimite dynasty of Misriyah, or Egypt, which first rose to power there, and from which dynasty the present Agha Khan of Bombay, the head of the sect of "Khojas," as they are "popularly" designated, claims to be a lineal descendant.

Sijilmásiyah is mentioned in the Arabic work entitled the 'Masalik wa Mamalik,' and in the 'Geography' of Ibn Haukal, and lies about 200 miles a little to the east of south from فاسرة, Fás (which Europeans, who take such strange liberties with foreign names, call *Fez*). These works state that from Kairwan to Sijilmásiyah is, by way of the desert, a journey of nearly fifty *marhalah* or days' journey, and that from Tahut to Sijilmásiyah is fifteen *marhalah*. When these works were written, Fás (Fez) had not yet fallen into the hands of the Isma'ilian, and Al-Káhirah (vul. "Cairo") had not yet been founded.

The events of the rise of this dynasty and sect show that Sijilmásiyah is a very ancient place, and is said to have been founded by the Romans. It is stated, according to several Oriental authorities, that Ubaid-ullah, Abu 'Ali, son of Muhammad, son of Abd-ullah, son of Abu-l-Kasim, son of Muhammad, son of Isma'il (after whom the dynasty took its name), eldest son of the Imam, Ja'far-us-Sadik, and who was held, by his followers and supporters, to be the only legal and rightful successor to the Imam-ship, and which the sect still hold, rose to power here; that he was referred to by Muhammad in the Kur'an; and it is from

a descendant of his that the promised "Mahdi" and "Imam," the Director and Guide—a pretender or two to which offices we have had lately—is to spring.

This Ubaid-ullah-al-Mahdi, the first of them who attained unto sovereign power, was born in 266 H. (879-80 A.D.), but some say in 259 H. (872 A.D.). On Sunday, the 7th of Zi-Hijjah, 296 H. (September, 909 A.D.), with the aid and support of Abd-ullah, the Sufi, he broke out at Sijilmásiyah against the governor of that territory on the part of the Abbasi Khalifahs of Baghdad, overcame him, and brought the territories of Afrikah and Kairwan under his sway; and on Friday, 8th of Rabi'-ul-Awwal, 297 H. (November, 910 A.D.), he was saluted as Khalifah.

Another account of his rise is, that when Ubaid-ullah-al-Mahdi reached Sijilmásiyah, the news thereof was brought to Malik Shai'a, the last of the Maliks of the Bani Badr, and Ubaid-ullah was seized by some of the people and brought before him. They said, "This is the person to acknowledge allegiance to whom Abu 'Abd-ullah-al-Shaba'i has been exhorting the people of Afrikah." On this, that Malik had Ubaid-ullah-al-Mahdi put in durance. Abd-ullah-al-Shaba'i, his advocate, hearing of this, assembled a great number of people together in order to free him by force, and moved to Sijilmásiyah accordingly. Malik Shai'a, hearing of their intention, put Ubaid-ullah-al-Mahdi to death in prison, left his body there, and fled the city. When Abu 'Abd-ullah and his followers reached it, Abu 'Abd-ullah proceeded to the prison, and found Ubaid-ullah-al-Mahdi dead. Some of the latter's companions were present there, and Abu 'Abd-ullah, out of fear lest his design should fail, brought one of them forward, and said to his followers, "This is the Mahdi;" for if he had not done so, and his adherents who had been gathered together to free him had found that the Mahdi had been killed, his scheme would have collapsed. The public prayers were accordingly read for him from the pulpits of Sijilmásiyah, Kairwan, and Rakakah on Friday, the 21st of Rabi'-ul-Akhir, 296 H. (December, 909 A.D.).

Ubaid-ullah-al-Mahdi is said to have brought Andalus (Andalusia) and most of the territories of the Maghrib under his sway, and that subsequently his *Khadim*, or domestic, the Ka'id, Johar, "subdued all the tracts as far west as the sea, Ukyanus (Oceanus), and the Paradise Islands, which are the extremity of the inhabited world, and from which philosophers commence the division or computation of the different climes."

It was this same Ubaid-ullah-al-Mahdi who, in Zi-Ka'dah, 303 H. (June, 916 A.D.), began to build a strong fortress and sanctuary in the neighbourhood of Kairwan—a distance of two days' journey—on the coast of the Mediterranean, and completed it in Shawwal, 308 H. (March, 921 A.D.), and there he died and was buried, on the 15th of Rabi'-ul-Awwal, 322 H. (March, 934 A.D.). His son, Al-Ka'im Bi-Amar-ullah, Abu-l-Kasim, Ahmad, who succeeded him, named the place Mahdiyah, after his father, the substantial ruins of which still remain. It was Ubaid-ullah-al-Mahdi's grandson, Al-Mu'azz Li-Din-ullah, Abu Tammim, Sa'd, who founded the city Al-Kahirah, or Misr-i-Jaddid (which Europeans vitiate into "Cairo"), and he was the first Isma'ilian Khalifah of the land of Misriyah, or Egypt.

From what I have before stated, it appears that Sijilmásiyah was a well-known city, and the seat of government of those parts from ancient times, and had been founded many centuries, probably, before Al-Mahdi's rise. It was known even then—and is still known, from what Mr. Harris says—as the "Madinat-ul-'Amirah" (not "Aamra," however, as he writes: the word is فاس), signifying "the royal or imperial city."

Sijilmásiyah was known to the old writers and travellers. Marmol states that *Sejelmesse* is the name of a province as well as of a town or city. "The province

is about 40 leagues long, and is inhabited by *Barbars* (vul. 'Berbers'). The town seems to have been built by a Roman captain that conquered all *Numidia* as far as *Messa*, and for that reason was christened, '*Sigillium Messa*,' i.e. 'The seat of his Conquest.' . . . It lies south of the *Atlas* range of mountains; and the *wādi* Ziz or river *Ziz*, which is a great river, and springs from the same mountains, passes from thence to the neighbourhood of *Garciluyn*, in the kingdom of *Fus* (Fez), traverses the territories of *Quenena*, *Matagara*, *Reteb*, and *Segelmesse*, after which it enters the *sahara*, or desert."

John Leo says, "The town of *Segelmesse* stood upon a plain near the river *Ziz*, and was surrounded with stately high walls. It had good buildings, magnificent temples and colleges, and a great many conduits for the river water. The air of the place is very moist in winter, but otherwise it is temperate and wholesome enough. *Tafilat*, famous for its dates, lies on the south-west side of this province."

From what I have mentioned above respecting Ubaid-ullah-al-Mahdi, it will be understood why Sijilmásiyah is still a place so venerated, and why on the two great *'ids* or feasts of the Musalman year, such concourses of people assemble there to say their prayers at the *Musalla*, near the mosque. The word (not "msala") means "a place of prayer," and also "a carpet to pray on."

Should Mr. Harris visit that part again, he might chance to find inscriptions among the ruins.

H. G. Raverty, Major.

March 30, 1895.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1894-1895.

Fourteenth Ordinary Meeting, June 24, 1895.—W. T. Blanford, Esq., LL.D., F.R.S., etc., Vice-President, in the chair.

Elections.—*Admiral Henry Boys; Right Rev. Bishop George W. Hamilton Knight Bruce (late Bishop of Mashonaland); Lieut. George S. Q. Carr, R.N., C.M.G.; Walter D. Cronin; Arthur Fisher; Malcolm A. C. Fraser; William Oswald Gilchrist; Franklin R. Kendall; Henry Kitching; Dr. Percy George McReddie; Major Alexander McD. Moore (Royal Irish Fusiliers); Thomas Pink; Major Hugh Montgomerie Sinclair, R.E.; Edward Stapleton; Dr. W. Stirling.*

The Paper read was:—

"The Sierra Madre of Mexico." By O. H. Howarth.

Special Meeting, July 1, 1895.—Sir G. D. Taubman Goldie, K.C.M.G., Vice-President, in the Chair.

Elections.—*Rev. Jacob Benjamin Anaman; S. L. Hinde; J. T. S. Jones; Thomas Henry Willis; Samuel Zivemer.*

The Paper read was:—

"A Recent Expedition to Borgu, on the Niger." By Captain F. D. Lugard, D.S.O., C.B.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce, Commercial.
C. R. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
J. = Journal.
M. = Mitteilungen.
Mag. = Magazine.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue, Revista.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

EUROPE.

Alps—Eastern. **Baedeker.**

The Eastern Alps, including the Bavarian Highlands, Tyrol, Salzburg, Upper and Lower Austria, Styria, Carinthia, and Carniola. Handbook for Travellers. By Karl Baedeker. Eighth Edition. Leipsic: Karl Baedeker, 1895. Size 6½ × 4½, pp. xxiv. and 518. *Maps, Plans, and Panoramas. Price* 10 *marks. Presented by the Editor.*

Austria—Transylvania. **Teutsch and Schuller.**

Die Art der Ansiedelung der Siebenbürger Sachsen. Von Dr. Friedrich Teutsch. Volksstatistik der Siebenbürger Sachsen. Von Professor Fr. Schuller.—Forschungen zur deutschen Landes- und Volkskunde . . . . herausgegeben von Dr. A. Kirchhoff. Neunter Band. Heft 1. Stuttgart: J. Engelhorn, 1895. Size 9½ × 6½, pp. 56. *Map.*

The writer of the first article traces the mode of settlement in Transylvania by the Saxon immigrants in the twelfth century (Franks of the Rhine). Divided originally into three great groups, the number became greatly increased, while within the groups the settlement was effected by villages. The mutual relations of the settlers are also traced, as well as that in which they stood to the king. The second paper shows that there is a steady though slow rate of increase of the German element in the country districts at the present day, although in many of the towns a decrease has been brought about by emigration.

Belgium—Colonization. *B.S R.G. Anvers* **19** (1895): 436–450. **Wauwermans.**

Résumé historique des tentatives coloniales de la Belgique. Par M. le Lieutenant-Général Wauwermans.

Bosnia and Herzegovina—Botany. **Murbeck.**

Beiträge zur Kenntniss der Flora von Südbosnien und der Hercegovina. Akademische Abhandlung. . . . Von Svante Murbeck. Lund, 1891. Size 11½ × 9, pp. 182.

Deals with a region hitherto imperfectly explored, from a botanical point of view, but important from the variety of elements represented in the flora.

England—Thames Valley. **Taunt.**

Goring, Streatley, and the neighbourhood, including Aldworth, Basildon, Goring Heath, Checkendon, Ipsden, Moulsford, Ashampstead, Nobes's Tomb, Hart's Wood, Collin's End, South Stoke, Moulsford Downs, the River Thames from Wallingford to Reading, the Æscesdune Battle-Field, etc. By Henry W. Taunt. Oxford: H. W. Taunt & Co. [1894]. Size 7½ × 5½, pp. 122. *Maps, Plans, and Photographs. Presented by the Author.*

The first of a series, illustrated by excellent reproductions of photographs, which is to deal with various sections of the Thames valley.

France—South-Eastern. **Baedeker.**

South-Eastern France from the Loire to the Riviera and the Italian Frontier, including Corsica. Handbook for Travellers. By Karl Baedeker. Second Edition. Leipsic: Karl Baedeker, 1895. Size 6½ × 4½, pp. xxiv. and 294. *Maps, Plans, and Panorama. Price 5 marks. Presented by the Editor.*

France—South-Western. **Baedeker.**

South-Western France from the Loire and the Rhone to the Spanish Frontier. Handbook for Travellers. By Karl Baedeker. Second Edition. Leipsic: Karl Baedeker, 1895. Size 6½ × 4½, pp. xxiv. and 294. *Maps and Plans. Price 5 marks. Presented by the Editor.*

Germany—Alsace and Lorraine. *B.G. Club Philadelphia* **1** (1895): 125–140. **Balch.**

Some Facts about Alsace and Lorraine. By Thomas Willing Balch. *With Map and Illustrations.*

Germany—Bavaria—Bibliography. **Gruber and Simonsfeld.**

Die in den Jahren 1892 und 1893 zur Landeskunde Bayerns erschienene Literatur. Von Ch. Gruber. Beiträge zur Landeskunde Bayerns. Bibliotheca Geographica Bavarica. Von H. Simonsfeld. Festschrift d. G. Ges. München. Munich: T. Ackermann, 1894. Size 10 × 6½, pp. 181–227.

Germany—Munich—Geology. **Ammon.**

Geologische Uebersichtskarte der Gegend von München. Von Ludwig von Ammon.—Festschrift d. G. Ges. München. Munich: T. Ackermann, 1894. Size 10 × 6½, pp. 239–388. *Map, Plates, etc.*

Germany—Saxony. ———

Kalender und Statistisches Jahrbuch für das Königreich Sachsen nebst Marktverzeichnissen für Sachsen und die Nachbarstaaten auf das Jahr 1895. Dresden: C. Heinrich, 1894. Size 8 × 5½, pp. 92, xii., and 272.

Hungary—Lake Balaton. ———

A. M. Földrajzi társaság Balaton-bizottságának Jelentése, 1892–93, évi működéséről. Budapest, 1894. Size 9 × 6½, p. 62. *Maps and Plate.*

Papers on Lake Balaton by different authors.

Hungary—Limnology. *Globus* **67** (1895): 287–288. **Sieger.**

Plattenseeforschungen. Von Dr. R. Sieger.

A short abstract of some of the more special results lately published by the "Plattensee Kommission."

Italy—Libraries. ———

Ministero di Agricoltura, Industria e Commercio (Direzione Generale della Statistica). Statistica delle Biblioteche. Parte I. Biblioteche dello stato, delle provincie, dei comuni ed altri enti morali aggiuntevi alcune biblioteche private accessibili agli studiosi, fra le più importanti per numero di volumi o per rarità di collezioni. Volume I. Piemonte, Liguria, Lombardia, Veneto ed Emilia. Rome: Tip. Nazionale, 1893. Size 10½ × 7½, pp. xlviii. and 208.

Ditto. Volume II. Toscana, Marche, Umbria, Roma, Abruzzi e Molise, Campania, Puglie, Basilicata, Calabrie, Sicilia e Sardegna. Rome: Tip. Nazionale, 1894. Size 10½ × 7½, pp. 296.

Contains the statistics of all the chief libraries of Italy, with notes respecting their formation, and the most important manuscripts or other collections possessed by each.

Italy—Lipari Islands. **Ludwig Salvator.**

Die Liparischen Inseln. Viertes Heft: Panaria. Prag: H. Mercy, 1895. Size 16½ × 13, pp. viii. and 30. *Map and Illustrations. Presented by the Archduke Ludwig Salvator.*

This part continues the detailed description of the several islands of the Lipari group, the general description, forming the conclusion of the whole work, having preceded it in date of publication.

Italy—Malaria. *Cosmos* **12** (1894–95): 14–19. **Raseri.**

Carta della Mortalità per infezione malarica nel Regno d'Italia. Nota del dott. Enrico Raseri. *With Map.*

In districts of limited extent, the mean annual mortality from malarial diseases amounted in 1890–92 to over 8 per thousand.

Norway, Sweden, etc. **Baedeker.**

Norway, Sweden, and Denmark. Handbook for Travellers. By K. Baedeker. Sixth Edition. Leipsic: Karl Baedeker. London: Dulau and Co., 1895. Size 6½ × 4½, pp. lxxx., 410, and 42. *Maps, Plans, and Panoramas. Price* 10 *marks. Presented by Messrs. Dulau & Co.*

Norway and Sweden—Botany. **Dusén.**

Om Sphagnaceernas Utbredning i Skandinavien. En Växtgeografisk Studie. Akademisk Afhandling . . . af Karl Fr. Dusén. Upsala, 1887. Size 11½ × 9, pp. vi. and 156. *Map.*

ASIA.

Armenia. **Stevenson.**

Armenia. By F. S. Stevenson. [From the *Contemporary Review*, February, 1895.] Size 10 × 6½, pp. [9].

Central Asia—Moghuls. **Elias and Ross.**

The Tarikh-i-Rashidi of Mirza Muhammad Haidar, Dughlát. A History of the Moghuls of Central Asia. An English version edited, with Commentary, Notes, and Map, by N. Elias. The translation by E. Denison Ross. London: Low and Co., 1895. Size 9 × 6, pp. xxiv. and 536. *Presented by the Secretary of State for India.*

This, the first published or complete English translation of the Tarikh-i-Rashidi, will be welcomed by all students of Asiatic history, while the editor's thorough acquaintance with the subject ensures the value of his notes and commentary.

Central Asia—Pamirs, &c. **Cumberland.**

Sport on the Pamirs and Turkistan Steppes. By Major C. S. Cumberland. Edinburgh and London: W. Blackwood and Sons, 1895. Size 8½ × 6, pp. x. and 278. *Map and Frontispiece. Price* 10*s.* 6*d. Presented by the Publishers.*

Major Cumberland's wanderings in search of sport led him in 1889 over the Pamirs and as far east as Kurla, in Chinese Turkestan. He was accompanied by Captain Bower, the results of whose cartographic work is embodied in the accompanying map by Bartholomew.

Central Asia—Tibet. **Sandberg.**

The Exploration of Tibet. By Graham Sandberg. [Written October, 1893, in *Calcutta Review*.] Size 9 × 5½, pp. 34. *Presented by the Author.*

Central Asia—Tibetan Language. **Sandberg.**

Handbook of Colloquial Tibetan. A practical guide to the language of Central Tibet. In three parts. By Graham Sandberg. Calcutta: Thacker, Spink and Co., 1894. Size 9 × 6, pp. 372. *Presented by the Author.*

This grammar deals with the general vernacular language of Tibet, as distinct from the old classical language, and modern dialectic varieties. The author has drawn not only on previously published material, but on his acquaintance with Tibetans from Lhasa and other districts.

India—Sikhim. ——

The Gazetteer of Sikhim. With an Introduction by H. H. Risley. Edited in the Bengal Government Secretariat. Calcutta: Bengal Secretariat Press, 1894. Size 11½ × 9, pp. xiv., xxii., and 392. *Maps and Plates. Presented by the Secretary of State for India.*

Java. **Snelleman and Niermeyer.**

Kustvormen op Java. By J. F. Snelleman and J. F. Niermeyer. Obergedrukt uit den Feestbundel van Taal-, Letter-, Geschied-, en Aardrijkskundige Bijdragen ter gelegenheid van zijn Tachtigsten Geboortedag aan Dr. P. J. Veth. Size 15 × 11, pp. 8. *Plates. Presented by the Authors.*

Korea. *Globus* **67** (1895): 261–266. **Kohlhauer.**

Ein Besuch in Port Hamilton und Chemulpo (Korea). Von Korvettenkapitän Kohlhauer. *With Illustrations.*

An account of a visit made in the latter part of 1883.

Manchuria. **Gowan.**

The Chinese Viceroyalty of Manchuria. (From the Russian of Lieut. Z. Matusovski's 'Sketch of the Chinese Empire.') Translated by Lieut.-Colonel W. E. Gowan. [Reprinted from the *Asiatic Quarterly Review* of January and April, 1895.] Size 10 × 6½, pp. 26. *Presented by the Translator.*

AFRICA.

Central Africa—The Congo. *B.S.R.G. Anvers* **19** (1895): 459–478. **Chaltin.**

Le Congo au point de vue physique, politique et économique. Par le capitaine Chaltin.

Central Soudan. *Ann. G.* **4** (1895): 346–368. **Mizon.**

Les Royaumes Foulbé du Soudan Central. Par M. le lieutenant L. Mizon.

Congo State—Stanley Pool. *B.S. d'Études coloniales* **2** (1895): 25–76. **Costermans.**

Le District du Stanley-Pool. Conférence par le Lieutenant Costermans.

Describes the inhabitants of the Stanley Pool district, and their manners and customs.

Egypt—Climate. *B.S. Khéd. G.* **4** *S.* (1895): 301–312. **Abbate.**

La lumière et la chaleur considérés comme agents bienfaisants du climat d'Égypte par S. E. Abbate Pacha.

Egypt—Irrigation. **Whitehouse.**

Irrigation in Egypt. By Cope Whitehouse. Size 10 × 7, pp. 22. *Illustrations. Presented by the Author.*

Egypt—Oases. *B.S. Khéd. G.* **4** *S.* (1895): 267–287. **Blundell.**

Notes sur une excursion à Khargueh, Dakhel, Farafrah et Behariyeh. Par H. W. Blundell. *With Plates.*

Egypt—Oases. *B.S. Khéd. G.* **4** *S.* (1895): 241–265. **Lyons.**

Notes sur la géographie physique des Oasis de Khargueh et de Dakhel. Par H. G. Lyons. *With Map.*

Madagascar. *Ann. G.* **4** (1895): 310–324. **Gautier.**

L'Ouest Malgache. Par M. E.-F. Gautier. *With Map and Sketches.*

North Africa—Sahara. **Vuillot.**

L'Exploration du Sahara. Étude historique et géographique. Par P. Vuillot. Préface du Colonel Prince de Polignac. Ouvrage accompagné de quarante-cinq Cartes-Itinéraires hors texte, douze Plans, et une Carte du Sahara au 1:4,000,000. Paris: A. Challamel, 1895. Size 11½ × 7½, pp. xiv. and 342. *Price 20 francs.*

A valuable summary of the various explorations of the Sahara from the time of Major Laing to the present day. It will receive special notice in our pages.

North Africa—Tunis. **Fitzner.**

Die Regentschaft Tunis. Streifzüge und Studien von Rudolf Fitzner. Berlin: Allgemeiner Verein für Deutsche Litteratur, 1895. Size 8 × 5¼, pp. x. and 360. *Map and Illustrations. Price 7s.*

Descriptions and impressions of Tunis and its inhabitants, drawn from a four years' residence in the country, giving a picture of the land after fourteen years of settled government. Some parts had already appeared in the form of magazine articles.

West Africa—Gold Coast. **Anaman.**

The Gold Coast Guide for the year 1895–96. Containing a large amount of information respecting the Gold Coast. By the Rev. Jacob Benjamin Anaman. London: C. H. Kelly. 1894. Size 7½ × 5, pp. 112. *Presented by the Author.*

NORTH AMERICA.

Hudson Bay Territory—Ungava District. **Turner.**

Ethnology of the Ungava District, Hudson Bay Territory. By Lucien M. Turner. (Edited by John Murdock.) Eleventh Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1889-90. By J. W. Powell. Washington: Government Printing Office, 1894. Size 12 × 8, pp. 159-350. *Illustrations. Presented by the Director of the U.S. Bureau of Ethnology.*

Newfoundland. **Fretwell.**

Newfoundland and the Jingoes. An appeal to England's honor. By John Fretwell. Boston, Mass.: G. H. Ellis, 1895. Size 8 × 5½, pp. 60. *Price* 1*s.*

Newfoundland. **Prowse.**

A History of Newfoundland from the English, Colonial, and Foreign Records. By D. W. Prowse. With a Prefatory Note by Edmund Gosse. London: Macmillan & Co., 1895. Size 10½ × 7, pp. xxiv. and 742. *Map, Portraits, Plates, etc. Price* 21*s. Presented by the Publishers.*

This will be referred to elsewhere.

Niagara. *American J.S.* **49** (3 S.) (1895): 249-270. **Taylor.**

Niagara and the Great Lakes. By Frank Bursley Taylor. *With Map and Sections.*

Mr. Taylor takes a middle course between the views of Professor J. W. Spencer and Mr. Warren Upham on the question of the geological history of the St. Lawrence.

North America. **Winsor.**

The Rival Claimants for North America, 1497-1755. By Justin Winsor. From *Proceedings of the American Antiquarian Society*, at the Annual Meeting, October 24, 1894. Worcester, Mass., 1895. Size 9½ × 6, pp. 22.

Shows the various ways in which the conflicting claims of the English and French in North America arose, and the principles on which they were based.

North America—Historical. **Winsor.**

The Mississippi Basin. The Struggle in America between England and France, 1697-1763, with full cartographical illustrations from contemporary sources. By Justin Winsor. Boston and New York: Houghton, Mifflin & Co., 1895. Size 9 × 6, pp. x. and 484. *Price* $4. *Presented by the Author.*

In this volume Mr. Justin Winsor continues his narrative of the progress of Discovery in North America and of the historical events connected with its settlement by Europeans. The period embraced is the important one in which England and France were rivals for supremacy in the Mississippi Basin, and the course of events is traced with great clearness down to the treaty of Paris, which gave England control of the whole territory from the sea-board to the Mississippi. As in the former volume, the history is elucidated by a valuable collection of reproductions of contemporary maps.

North American Ethnology. **Dorsey.**

A Study of Siouan Cults. By James Owen Dorsey. Eleventh Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1889-90. By J. W. Powell. Washington: Government Printing Office, 1894. Size 12 × 8, pp. 351-544. *Illustrations (some coloured). Presented by the Director of the U.S. Bureau of Ethnology.*

North American Ethnology. **Stevenson.**

The Sia. By Matilda Coxe Stevenson. Eleventh Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1889-90. By J. W. Powell. Washington: Government Printing Office, 1894. Size 12 × 8, pp. 1-158. *Plates (some coloured). Presented by the Director of the U.S. Bureau of Ethnology.*

North American Ethnology. **Thomas.**

Report on the Mound Explorations of the Bureau of Ethnology. By Cyrus Thomas. Twelfth Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1890-91. By J. W. Powell. Washington: Government Printing Office, 1894. Size 12 × 8, pp. 1-742. *Map and Illustrations. Presented by the Director of the U.S. Bureau of Ethnology.*

The recent examination of the ancient mounds of the United States leads the

writer (*inter alia*) to the following conclusions: that the Indians and mound-builders are one and the same people; that particular works are attributable to tribes known to history; that the builders were not Mayas or Mexicans, or related to the Pueblo tribes of New Mexico; and that many of the mounds were built subsequently to the advent of Europeans.

North American Ethnology—Dakota Grammar, etc. **Riggs.**

Dakota Grammar, Texts, and Ethnography. By Stephen Return Riggs. Edited by James Owen Dorsey. Department of the Interior, U.S. Geographical and Geological Survey of the Rocky Mountain Region, J. W. Powell in charge. Contributions to North American Ethnology, volume ix. Washington: Government Printing Office, 1893. Size 12 × 9, pp. xxxii. and 240. *Presented by the Director of the U.S. Bureau of Ethnology.*

Includes notes on the Dakota tribes, their myths, migrations, etc., collected by the late Dr. Riggs during nearly fifty years' work among them.

United States. **Latané.**

Johns Hopkins University Studies in Historical and Political Science. Thirteenth Series, iii.-iv. The Early Relations between Maryland and Virginia. By John H. Latané. Is History past Politics? By the Editor. Baltimore, 1895. Size 10 × 6½, pp. 82.

United States—Colorado River. **Powell.**

Canyons of the Colorado. By J. W. Powell. Meadville, Pa.: Flood and Vincent, 1895. Size 12 × 9, pp. 400. *Portrait and Illustrations. Presented by the Publishers.*

This handsome and profusely illustrated volume, by the former Director of the United States Geological Survey, is to be welcomed as the first complete popular account of the important scientific expedition which explored the wonders of the Colorado region between the years 1869 and 1872. The scientific results, which formed its main object, have, of course, long since been published; but though Major Powell was induced to add to his report in 1875 a reproduction of his daily journal, no popular history of the expedition, commensurate with its importance as the basis of all our knowledge of that interesting region, had till now appeared. The illustrations have been brought together from a variety of sources, some of them having already appeared in the original report, and give a vivid idea, not only of the natural wonders of the country, but of the difficulties and dangers which were surmounted by the members of the expedition.

United States—Gravity Measurements. **Putnam and Gilbert.**

Results of a Transcontinental Series of Gravity Measurements, by George Rockwell Putnam; and Notes on the Gravity Determinations reported by Mr. G. R. Putnam, by Grove Karl Gilbert. Washington, 1895. Size 9½ × 6, pp. 46. *Plate. Presented by the Authors.*

United States—Maryland—Baltimore. ———

Report of the City of Baltimore Topographical Survey, to the Mayor and City Council of Baltimore, for the fiscal year ending December 31, 1894. Baltimore: W. J. C. Dulany, 1895. Size 9 × 6, pp. 220. *Maps. Presented by Josiah Pierce, Esq., Jr.*

United States—Minnesota—Itasca State Park. **Brower.**

The Report of the Commissioner of the Itasca State Park to His Excellency Knute Nelson, Governor, December 8, 1892, to December 1, 1894. St. Paul, Minn., 1895. Size 9 × 6, pp. 48. *Maps and Illustrations.*

United States—Oregon. *National G. Mag.* **6 (1895)**: 239-284. **Mitchell.**

Oregon, its History, Geography, and Resources. By John H. Mitchell.

CENTRAL AND SOUTH AMERICA.

Brazil—Guarani Language. **Restif.**

Lexicon Hispano-Guaranicum "Vocabulario de la lengua Guaraní" inscriptum a Reverendo Patre Jesuita Paulo Restivo . . . redimpressum necnon praefatione notisque instructum opera et studiis Christiani Frederici Seybold. Stuttgart: W. Kohlhammer, 1893. Size 8 × 5½, pp. x and 546. *Presented by the Publisher.*

Brazil—Guarani Language. **Restif.**

Linguae Guarani Grammatica Hispanico a Reverendo Patre Jesuita Paulo Restivo . . . redimpressa necnon praefatione notisque instructa opera et studiis Christiani Frederici Seybold. Stuttgart: W. Kohlhammer, 1892. Size 8 × 5½, pp. xiv. and 330. *Presented by the Publisher.*

These reprints of the Guarani Grammar and Vocabulary, published by the Jesuit Paul Restif in 1722, were suggested by the late Emperor of Brazil, as a contribution to the Columbus celebration in 1892, and carried out after his death under the auspices of Prince Peter of Saxe Coburg and Gotha. They are made from the single copy known to exist in Europe, which was presented to that prince by Dr. J. Platzmann of Leipzig. Their value depends not only upon the rareness of the original work, and its importance for the study of the Guarani language, but also on the light which it throws on the changes to which that language has been subject since the beginning of last century. A preface and notes are supplied by the editor, Dr. C. F. Seybold.

Chile.

Anuario Hidrografico de la Marina de Chile. Año 17. Santiago de Chile, 1894. Size 10 × 7, pp. 472. *Plates. Presented by the Chilian Admiralty.*

Guiana. **Rodway.**

In the Guiana Forest. Studies of Nature in relation to the struggle for life. By James Rodway. With Introduction by Grant Allen. Second Edition. London: T. Fisher Unwin, 1895. Size 8 × 5½, pp. xxiv. and 242. *Illustrations. Price 7s. 6d.*

This is a valuable book, written with much sympathy for nature, keen scientific insight, and expressed in clear and graceful language.

Nicaragua Canal. **Hurst.**

Nicaragua Canal. By Thomas Wright Hurst. From *Clay Record*, April 12, 1895. Size 11½ × 9½, pp. [4].

Advocates the choice of the Darien route for a ship canal in preference to that by Lake Nicaragua.

Uruguay. **Brendel.**

Uruguay. Von K. Brendel.—Festschrift d. G. Ges. in München. Munich: T. Ackermann, 1894. Size 10 × 6½, pp. 23–48.

Uruguay. **Gummá y Marti.**

Cuarto Centenario del Descubrimiento de América. Inmigración y Colonización Europea en la República Oriental del Uruguay trabajo presentado al Congreso Geográfico Hispano-Portugués-Americano por Alfredo Gummá y Marti. Barcelona, 1894. Size 11 × 7½, pp. 38. *Presented by the Author.*

AUSTRALASIA.

New South Wales—Geology. **Etheridge.**

Department of Mines and Agriculture. Memoirs of the Geological Survey of New South Wales. Palæontology, No. 8. Contributions to a Catalogue of Works, Reports, and Papers on the Anthropology, Ethnology, and Geological History of the Australian and Tasmanian Aborigines. Part III. By R. Etheridge, Junr. Sydney: C. Potter, 1895. Size 12½ × 10, pp. 40. *Presented by the Minister for Mines and Agriculture, New South Wales.*

New South Wales—Meteorology. **Russell.**

Results of Rain, River, and Evaporation Observations made in New South Wales, during 1893, under the direction of H. C. Russell. Sydney: C. Potter, 1894. Size 9½ × 6, pp. 1. and 176. *Maps and Diagrams. Price 3s. 6d.*

Queensland—Artesian Water. **Jack.**

Queensland. Department of Mines. Geological Survey. Bulletin No. 1. Artesian Water in the Western Interior of Queensland. By Robert L. Jack. Brisbane: E. Gregory, 1895. Size 9 × 5½, pp. 16. *Presented by the Author.*

POLAR REGIONS.

Arctic Expedition. *B. G. Club Philadelphia* **1** (1894–95): 121–123. **Peary.**

Preliminary Report on the Arctic Expedition of 1893–94. By Civil Engineer Robert E. Peary.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Astronomy. **Peal.**

A Theory of Lunar Surfacing by Glaciation. By S. E. Peal. Calcutta: Thacker, Spink and Co., 1889. Size 9½ × 6½, pp. 26. *Illustrations. Presented by the Author.*

Atmosphere—Bibliography. ——

Catalogue of Works on Atmospheric Physics and Climatology. Library of Lorin Blodget.—From Proceedings commemorative of the One Hundred and Fiftieth Anniversary of the Foundation of the American Philosophical Society . . . May 22–26, 1893, pp. 248–269. Philadelphia, 1894. Size 9½ × 6.

Books of Reference. ——

Connaissance des Temps ou des Mouvements Célestes, pour le Méridien de Paris, à l'usage des Astronomes et des Navigateurs, pour l'an 1897, publiée par le Bureau des Longitudes. Paris: Gauthier-Villars et Fils, 1894. Size 9½ × 6½, pp. vi., 756, and 108. *Charts.*

Coasts and Coast Settlements. **Ratzel.**

Zur Küstenentwickelung. Anthropogeographische Fragmente. Von Friedrich Ratzel. Festschrift d. G. Ges. München. Munich: T. Ackermann, 1894. Size 10 × 6½, pp. 67–90.

Entomology. **Elwes.**

Address to the Entomological Society. [By — Elwes.] Size 8½ × 5½, pp. 36.

Deals mainly with the question of Entomological Regions.

Geography of Plants. **König.**

Naturwissens. Wochenschrift **10** (1895): 77–81, 95–98, 117–124.

Die historische Entwickelung der pflanzengeographischen Ideen Humboldts. Von Clemens König.

An investigation of the external influence to which Humboldt's ideas on the geography of plants may be ascribed.

Gravity-determinations. ——

Relative Schwerebestimmungen durch Pendelbeobachtungen. Ausgeführt durch die K. und K. Kriegs-Marine in den Jahren 1892–1894. Herausgegeben vom K. und K. Reichs-Kriegs-Ministerium, Marine-Section. Wien: Carl Gerold's Sohn, 1895. Size 10½ × 7, pp. viii. and 630. *Maps and Plates.*

Meteorology—Winds. **Frejlach.**

Věstnik Král. České Společnosti Náuk. Třida mathematicko-přirodovědecká. 1894. XXXIV. Intorno all' andamento diurno che ha la frequenza di rotazioni del vento nell' intervallo di 4 ore a Praga. Dell Dott. Giuseppe Frejlach. Prague, 1894. Size 10 × 6½, pp. 10.

Meteorology—Winds. **Frejlach.**

Sitzungsberichte der Königl. böhmischen Gesellschaft der Wissenschaften. Mathematisch-naturwissenschaftliche Classe. 1895. II. Zur Kenntniss der anemometrischen Verhältnisse von Prag. Von Dr. Josef Frejlach. Prag, 1895. Size 9½ × 6½, pp. 4.

Zoogeography. **Beddard.**

A Text-Book of Zoogeography. By Frank E. Beddard. Cambridge: the University Press, 1895. Size 7½ × 5, pp. viii. and 246. *Maps. Price* 6*s. Presented by the Cambridge University Press.*

An outline of the leading facts and conclusions of zoological distribution, based largely on the works of Wallace and others, but as far as possible illustrated by

instances not previously made use of, and brought up to date from recent sources of information. The work should be useful as an introduction to the interesting subject with which it deals.

GENERAL.

Anthropology. **Sergi.**

Smithsonian Miscellaneous Collections, 969. The Varieties of the Human Species. Principles and Method of Classification. By Giuseppe Sergi. Washington: the Smithsonian Institution, 1894. Size 9½ × 6, pp. 62. *Illustrations. Presented by the Smithsonian Institution.*

An attempt at a systematic classification of the human species into varieties and subvarieties, according to definite variations in the shape of the skull, sixteen typical shapes, corresponding to as many human varieties, being laid down.

Bimetallism. **Jamieson and others.**

The Silver Question. Injury to British Trade and Manufactures. The paper by George Jamieson which won the Bimetallic Prize offered by Sir Henry M. Meysey-Thompson in 1894, together with two other papers on the same subject by Thomas Holyoake Box (Yokohama); and David Octavius Croal (London); also a Preface and Sequel by Sir Henry M. Meysey-Thompson, Bart., M.P. London: Effingham Wilson, 1895. Size 9½ × 6, pp. vi. and 76. *Price* 6*d*. *Presented by the Publisher.*

Biography—Daendels and Raffles. **Deventer.**

Daendels-Raffles. A dissertation on the two celebrated Governors of Java during one of the most important periods in the history of the Dutch Colonies in the East Indies. By M. L. Van Deventer. Translated from the 'Indische Gids' by Geo. G. Batten. London: printed . . . . by E. Marlborough & Co., [1894]. Size 8½ × 5½, pp. 128.

Biography—Westenrieder. **Gruber.**

Die Verdienste Lorenz von Westenrieders um die bayerische Geographie. Von Dr. Christian Gruber. Festschrift d. G. Ges. München. Munich: T. Ackermann, 1894. Size 10 × 6½, pp. 91–118.

Cities. **Reclus.**

The Evolution of Cities. By Elisée Reclus. [From the *Contemporary Review*, February, 1895.] Size 10 × 6½, pp. 19. *Presented by the Author.*

Columbus. *Rev. G.* **36** (1895): 189-199, 252-260. **Levasseur**

Christophe Colomb d'après la Raccolta di Documenti e Studi pubblicati dalla R. Commissione Colombiana del Quarto Centenario dalla Scoperta dell' America par E. Levasseur.

Decimal System. **Walmsley.**

The Decimal Problem and its Urgency, with some remarks on its solution. By Professor R. Mullineux Walmsley. Size 8½ × 6, pp. [16]. *Presented by the Author.*

Educational—Textbook. **Molard.**

Cours de Géographie rédigé conformément au nouveau programme d'admission à l'École Spéciale Militaire pour 1891. Par J. Molard. Europe. With Atlas. Paris: Jouvet & Co., 1891 (Atlas, 2nd edition, 1895). Size 7½ × 5 (Atlas, 13 × 10), pp. viii. and 336. *Price* (*Text and Atlas*), 11*s*.

This deals with the first section (Europe) of the programme for the Study of General Geography laid down for candidates for admission into the French Special Military School. The Physical Geography of Europe is first treated of in detail, the main features of orography, hydrography, etc., being clearly shown in the large series of physical sketch-maps included in the Atlas. In the political section the main idea kept in view is that of the influence which the configuration of the earth has had on the distribution of the human race.

Educational. *Deutsche G. Blätter* **18** (1895): 35–46. **Oppel.**

Ueber die Stellung und Behandlung der Wirtschaftsgeographie im Schulunterricht. Von A. Oppel.

Educational. ———

The Value of Geography as an Educational Instrument; with some hints on its teaching in schools. [From the *Australian Teacher*. Vol. i. No. 10, November, 1894, pp. 2-7.] Size 11 × 9. *Presented by A. H. Coombes, Esq.*

Geodesy. **Weiss and Schram.**

Publicationen für die Internationale Erdmessung. Astronomische Arbeiten des K. K. Gradmessungs-Bureau ausgeführt unter der Leitung des Hofrathes Theodore v. Oppolzer. Nach dessen Tode herausgegeben von Prof. Dr. Edmund Weiss und Dr. Robert Schram. VI. Band. Längenbestimmungen. Vienna: F. Tempsky, 1894. Size 12½ × 10, pp. 196. *Presented by the K. K. österreichische Gradmessungs-Bureau.*

Geographical Discovery. *B.G. Club Philadelphia* **1** (1894–95): 85–120. **Heilprin.**

The Progress of Discovery and the Lands of Promise to the Explorer. By Prof. Angelo Heilprin.

History of Geographical Measurement. **Ambronn.**

Deutsche G. Blätter **18** (1895): 46–63.

Das was uns im Laufe der Zeit über Grösse, Gestalt und Masse der Erde bekannt geworden ist. Von Dr. Ambronn.

Magnetism. *J.S. Arts* **43** (1895): 558–567. **Reinold.**

Deviation of the Compass. By Prof. A. W. Reinold.

Malay Archipelago—Bima-Dutch Dictionary. **Jonker.**

Bimaneesch-Hollandsch Woordenboeh. Door J. C. G. Jonker. Verhandelingen van het Bataviaasch Genootschap van Kunsten en Wetenschappen, Deel xlviii. 1ste Stuk. Batavia, 1893. Size 10½ × 7½, pp. 134.

Mohammedan Countries. **Hirth.**

Supplément au Volume V. du "T'oung-pao." Die Länder des Islâm nach Chinesischen Quellen. Von Prof. Dr. Friedrich Hirth. Leyden, E. J. Brill, 1894. Size 10 × 6½, pp. 64. *Presented by the Author.*

Mountaineering. **Mummery.**

My Climbs in the Alps and Caucasus. By A. F. Mummery. London: T. Fisher Unwin, 1895. Size 11 × 7½, pp. xii. and 360. *Illustrations. Price* 21*s. Presented by the Publisher.*

This work will be specially noticed.

Ore-Deposits. **Sjögren.**

Beiträge zur Kenntniss der Erzlagerstätten von Moravica und Dognaeska im Banat und Vergleichung derselben mit den schwedischen Eisenerzlagerstätten. Von Hj. Sjögren. [From Jahrbuch der k. k. geol. Reichsanstalt, 1886, 36 Band. 4 Heft.] Size 10½ × 7½, pp. [62]. *Presented by the Royal University of Upsala.*

Origin of Species. **Soria y Mata.**

Arturo Soria y Mata. Origen Poliédrico de las Especies. Unidad, origen, reproducción y síntesis de las formas. Madrid, 1894. Size 9 × 6½, pp. 86. *Illustrations.*

NEW MAPS.

By J. Coles, *Map Curator*, R.G.S.

EUROPE.

Alps. **Penck and Richter.**

Atlas der Österreichischen Alpenseen mit Unterstützung des hohen k. k. Ministeriums für Cultus und Unterricht; herausgegeben von Dr. Albrecht Penck und Dr. Eduard Richter. I. Lieferung: Die Seen des Salzkammergutes 18 Karten und 100 Profile auf 12 Tafeln. Hauptsächlich nach den Lothungen von Hofrath Dr. Friedrich Simony em. Prof. der Geographie an der Universität Wien, entworfen und gezeichnet von Dr. Johann Müllner. Wien, 1895. *Presented by Dr. Albrecht Penck.*

This is the first issue of an atlas containing maps of the lakes in the Austrian Alps. The depths of the lakes, and the elevations of the surrounding country, are represented by figures and a series of contours. In addition to this the maps are orographically coloured, and a section of each lake is given.

England and Wales. **Ordnance Survey.**

Publications issued since June 8, 1895.

1-inch—General Maps:—

ENGLAND AND WALES:—287, hills engraved in black and brown, 1*s.*

6-inch—County Maps:—

ENGLAND AND WALES:—**Lancashire,** 52 N.W., 54 S.E., 56 S.W., 73 S.E., 81 N.E. on one. **Yorkshire,** 8 S.W., 14A S.W., 19 S.W., S.E., 29 S.E., 30 S.W., 32 S.E., 44 S.W., S.E., 45 N.W., 60 N.E., S.W., 70 N.W., 71 N.W., 78 S.W., 87 N.W., S.W., 88 N.W., 89 N.E., 93 N.E., 156 N.W., N.E., S.E., 173 S.E., 200 N.W., S.E., 1*s.* each.

25-inch—Parish Maps:—

ENGLAND AND WALES:—**Devonshire,** revised, CXVII. 6, 7; CXXIII. 11; CXXX. 4, 3*s.* each.

Town Plans—5-feet scale:—

London—Re-survey, IV. 31, 41, 42, 44, 51, 52, 54, 64, 82; VI. 97; VIII. 5, 15, 63, 84, 85, 86, 87; X. 22, 86, 87, 88, 2*s.* 6*d.* each.
Stockport (Revised) I., VII., XI., 2*s.* 6*d.* each. Index, 2*d.*

——— 10-feet scale:—

Woolwich and Plumstead (Revised) II., **5,** 25; II. **6,** 9, 16, 21, 22; II. **9,** 5, 10; II. **10,** 5, **6,** 8, 9, 2*s.* 6*d.* Index, 4*d.*

Hornsey, II. **60,** 1, 4, 2*s.* 6*d.* each.
(*E. Stanford, Agent.*)

England. **Bartholomew.**

The New Reduced Ordnance Survey Map of the County of Surrey. By J. G. Bartholomew, F.R.G.S. Scale 1 : 126,720 or 2 stat. miles to an inch. W. H. Smith & Son, London. *Price* 2*s.*, *mounted on cloth. Presented by J. Bartholomew & Co.*

This is one of Bartholomew's reduced Ordnance Survey Maps. The roads are coloured brown, the elevations are given in feet, and it is well suited to the wants of cyclists and pedestrians.

Flag Maps. **Morley.**

Flag Maps (patented by H. Morley, Stockport):—1. England. Geographical Lessons and "Occupation" combined. For the use of younger children in School Classes. W. & A. K. Johnston, Edinburgh and London. *Price* 8*d. Presented by the Publishers.*

Russia. **Bober.**

Dislokations-Karten der gesammten Russischen Armee (2 Blatt) und Tabellaris Uebersichten der Eintheilung der russischen Armee in Europa und in Asien. Entworfen von Bober, Hauptmann und Kompagnie-Chef im Infanterie-Regiment Freiherr Hiller von Gaertringen (4 Posenschen) Nr. 59. Ernst Siegfried Mittler & Sohn, Berlin, 1895. *Price* 15*s.* 6*d.*

Switzerland. **Handtke and Herrich.**

Schweiz, bearbeitet von F. Handtke und A. Herrich. Scale 1 : 600,000 or 9·4 stat. miles to an inch. Carl Flemmings Generalkarten. No. 21. Druck und Verlag von Carl Flemming in Glogau. *Price* 1·5 *mark.*

As this map is of handy size, and clearly shows all means of communication, as well as the topographical features of the country, it is well suited to the requirements of tourists visiting Switzerland.

ASIA.

Indian Government Surveys. **Surveyor-General of India.**

Indian Atlas, 4 miles to an inch, Sheet 47, parts of Ludhiana, Jullundur, etc. (Punjab), and parts of district Dehra Dun and the Native State of Gurhwal (North-West Provinces). Quarter Sheets, 15 S.W., parts of districts Bannu, Dera Ismail Khan, Shahpur, and Kohat (Punjab); 31 N.W., parts of districts Ferozepore, Montgomery, Lahore, and of Native States Bahawalpur (Punjab) and Bickaneer (Rajputana); 60 S.E., parts of districts Mysore, Bangalore, Tumkur, and Kolar (Mysore), and of Salem and Coimbatore (Madras Presidency); 67 S.W., parts of districts Bareilli, Budaun, Aligarh, Etah, Moradabad, Bulandshahr, Shahjahanpur, and of Rampur Native State (North-West Provinces); 91 S.E., parts of Raipur, Nawagarh, Khariar, Borasamar, Patna, and Phuljhar (Central Provinces); 129 N.E., parts of district Lakhimpur (Assam), and the Miri

and Mishmi Hills; 131 N.W., parts of districts Cachar and Naga Hills and Manipur (Native States).—India, 1 inch to 256 miles, 1894.—Skeleton Map of the Punjab and surrounding countries, 1874, Corrections to 1892, 1 inch to 32 miles.—Bombay Survey, 1 inch to a mile, No. 159, parts of districts Surat, Thana, Násik, and Daman (Portuguese Territory), and Dharampor State, Seasons 1874–75, 1882–83, and 1891–92; No. 206, parts of Ratnagiri District and Kolhápur and Bavda States, Season 1892–93; No. 207, parts of district Ratnagiri and Kolhapur, Bavda, and Savantvadi States, Season 1892–93; No. 227, districts Nasik and Ahmednagar, Seasons 1871–73; No. 241, parts of district Belgaum and Kolhapur and Inchalkaranji States, Season 1892–93; No. 303, parts of Belgaum District and Mudhol, Jamkhandi, Aundh, Kurundvad, and Sangli States, Season 1892–93.—Bengal Survey, 1 inch to a mile, No. 207, districts Hazaribagh and Sonthal-Parganas, Season 1848; No. 359, district Mymensingh, Season 1856–57.—Hyderabad Survey, 1 inch to 2 miles, Nos. 101, 102, 103, 125, 126, 127, Mulkaid Circar, Season 1824–25; Nos. 128, 168, 169, Bhonagheer Circar, Season 1827–28.—Lower Burma Survey, 1 inch to a mile, districts Hanthawaddy and Thongwa, Seasons 1881–82 and 1887–90; Nos. 563, 570, 571, 579, 580, 581, district Mergui, Seasons 1889–93.—North-West Provinces and Oudh Survey, 1 inch to a mile, No. 46, districts Bijnor, Moradabad, Garhwal, and Naini Tal, Seasons 1868–69, 1873–76, 1888–90; No. 100 (2nd edit.), districts Pilibhit and Kheri, Seasons 1865–66 and 1869–70; No. 250, districts Naini Tal and Almora, Seasons 1872–73 and 1888–90; No. 251, districts Naini Tal and Almora, Seasons 1872 and 1888–90.—North-Eastern Frontier, 1 inch to 4 miles, part of Sheet No. 15 S.W., parts of district Cachar, Manipur Native State, and North Lushai Hills (Assam), and of Chin Hills (Burma), Season 1893–94.—South-Eastern Frontier, 1 inch to 4 miles, No. 6 N.W. (7th edit.), parts of district Toungoo (Lower Burma), of district Yamethin, of South Shan States and Karenni (Upper Burma), and of Siam, Seasons 1887–94.—Indus Riverain Survey, 1 mile to an inch, No. 40, district Shikarpur and Khairpur State, Season 1892–93; No. 59, district Shikarpur and Khairpur State, Season 1892–93; No. 78, district Upper Sind Frontier, Season 1892–93; No. 79, districts Upper Sind Frontier and Shikarpur, Season 1892–93; No. 80, districts Upper Sind Frontier and Shikarpur, Season 1892–93; No. 98, districts Dera Ghazi Khan, Upper Sind Frontier, and Shikarpur, and Bahawalpur State, Season 1892–93; No. 99, districts Upper Sind Frontier and Shikarpur, and Bahawalpur State, Season 1892–93; No. 60 and portion of No. 81, district Shikarpur and Khaipur State, Season 1892–93.—District Kámrúp, Assam, 4 miles to an inch, 1894.—District Mymensingh, Lower Provinces, Bengal, 4 miles to an inch, 1894.—District Gorakhpur, 1883–88, 2 miles to an inch, 1894, 6 sheets.—Survey of India Department, Chart of Triangulation of No. 18 party (Himalaya), Sheet No. 290 (Punjab), 1 inch to 2 miles, Season 1884–85.—Central Provinces Survey, index to the Forest Survey in district Damoh, No. 14 party, 1894.—*Presented by H.M. Secretary of State for India, through the India Office.*

AFRICA.

Africa. **Société de Géographie de Paris.**

Afrique, 1895. Scale 1: 10,000,000 or 157·8 stat. miles to an inch. Dessinée par J. Hansen. Société de Géographie de Paris. Maison Andriveau-Goujon. H. Barrère, Paris.

Orange Free State. **Herfst.**

School Kaart van den Oranjevrijstaat samenjesteld door J. J. Herfst, vervaardiger van de Ordinantie kaart van den Oranjevrijstaat. Scale 1: 780,000 or 12·6 stat. miles to an inch. C. Borckenhagen & Co., Bloemfontein. *Presented by C. B. Elliott, Esq.*

AUSTRALIA.

Australia. **Bartholomew.**

Commercial map of Australia. By J. G. Bartholomew, F.R.G.S. Scale 1: 6,000,000 or 94·6 stat. miles to an inch. J. Bartholomew & Co., Edinburgh. *Price 3s., mounted on cloth. Presented by the Publishers.*

This map has been drawn for the use of persons having business connections with Australia. Special attention has been given to the railways, steamer routes, telegraph

lines and cables. It is also well adapted for general reference, having been very nicely drawn and carefully brought up to date.

GENERAL.

Historical Geography. **Schrader.**

Atlas de Géographie Historique, ouvrage contenant 54 grandes Cartes doubles en couleurs, accompagnées d'un Texte Historique au dos et d'un grand nombre de cartes de détail, figures, diagrammes, etc. Par une Réunion de Professeurs et de Savants sous la direction géographique de F. Schrader, directeur des travaux cartographique de la librarie Hachette et C^ie^. 14^e^ Livraison. Paris: Librairie Hachette et C^ie^, 1895. *Price 1fr. 50c. each part. Presented by the Publishers.*

Part 14 of this atlas contains the following maps: the countries bordering on the Mediterranean at the time of Justinian; the Eastern Empire towards the middle of the tenth century; the Church at the time of Gregory the Great; France and the neighbouring countries in the year 987, with three insets of France at the accession of Hugues Capet, at the beginning of the reign of Henry I., and in the eleventh century; France in 1681; the United Provinces during the seventeenth century; Sweden after the treaty of 1660; the Orient after the treaty of Carlowitz. These maps are all well drawn, and are accompanied by well-written explanatory notes.

The World. **The "Times."**

The Times Atlas. Published at the *Times* Office, London. Parts 10, 11, 12, 13. Complete in fifteen weekly parts. *Price 1s. each part. Presented by the Publishers.*

The present issues of this atlas contain the following maps: Part No. 10—North Polar Regions and four insets, Afghanistan and Baluchistan, Siam and Malay Archipelago (one inset), Southern Scandinavia and one inset, Norway and Sweden, The Caucasus, Greece and one inset. Part No. 11—North-West Africa and one inset, United States, Belgium and Luxemburg, Holland, Spain and Portugal. Part No. 12—China and Japan with two insets, Japan and five insets, North-East Africa, North America, Australia and New Zealand with two insets.

The World. **Philip.**

The Religions of the World, with the stations of the London Missionary Society. Compiled and published for the London Missionary Society, by George Philip & Son, London and Liverpool, 1895. *Price 6d. Presented by Messrs. G. Philip & Son.*

CHARTS.

Pilot Charts. **U.S. Hydrographic Office.**

Pilot Charts of the North Atlantic Ocean for June, 1895, and North Pacific Ocean for July, 1895. Published monthly at the Hydrographic Office, Washington, D.C. Charles D. Sigsbee, Commander U.S. Navy, Hydrographer. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Antarctic Regions. **Bruce.**

23 Photographs taken in the Antarctic Regions in the neighbourhood of the South Shetland Islands, etc., by Mr. W. S. Bruce, on board the *Balæna*, 1893. *Presented by B. Leigh Smith, Esq.*

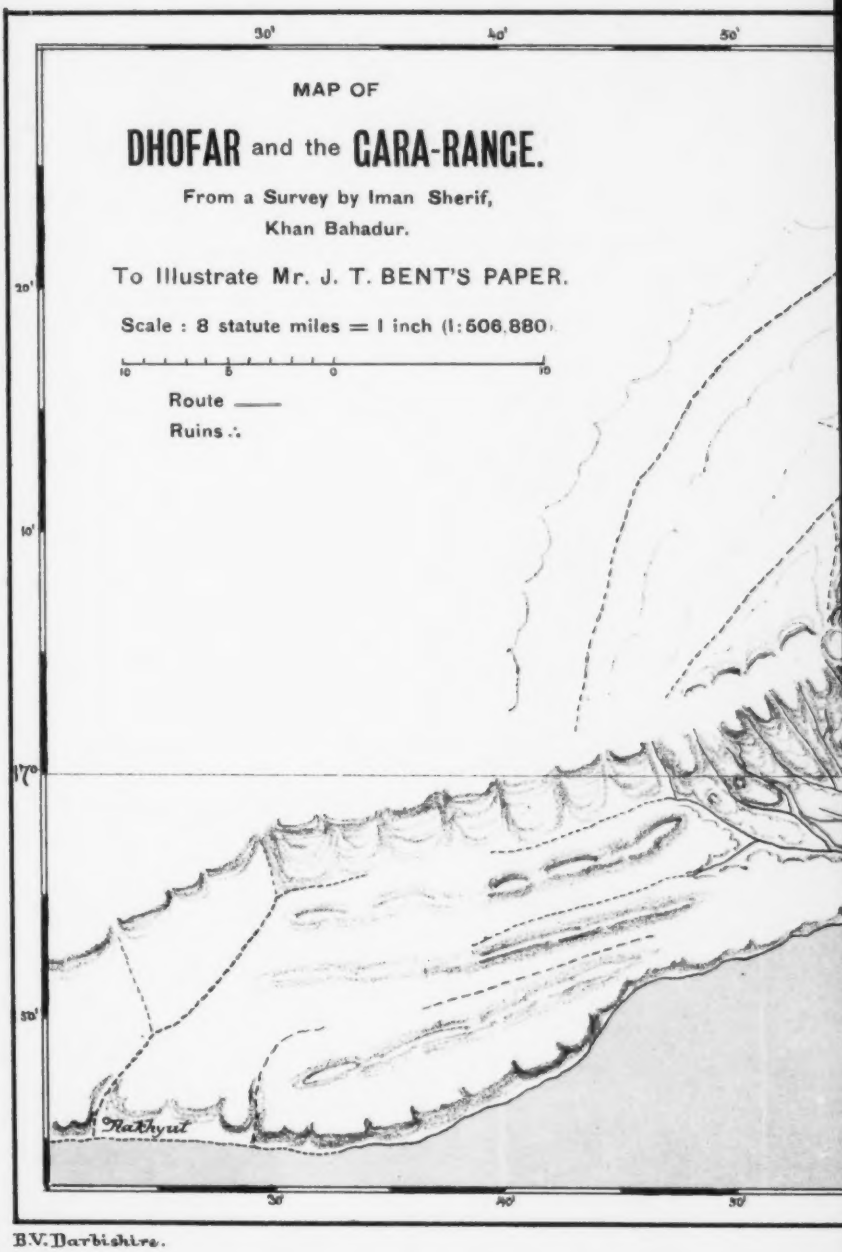
This series of photographs was taken by Mr. W. S. Bruce on board the *Balæna*, during a cruise towards the Antarctic in 1893.

Japan. **Weston.**

21 Photographs of Natives and Scenery of Japan, taken by the Rev. Walter Weston. *Presented by Rev. Walter Weston.*

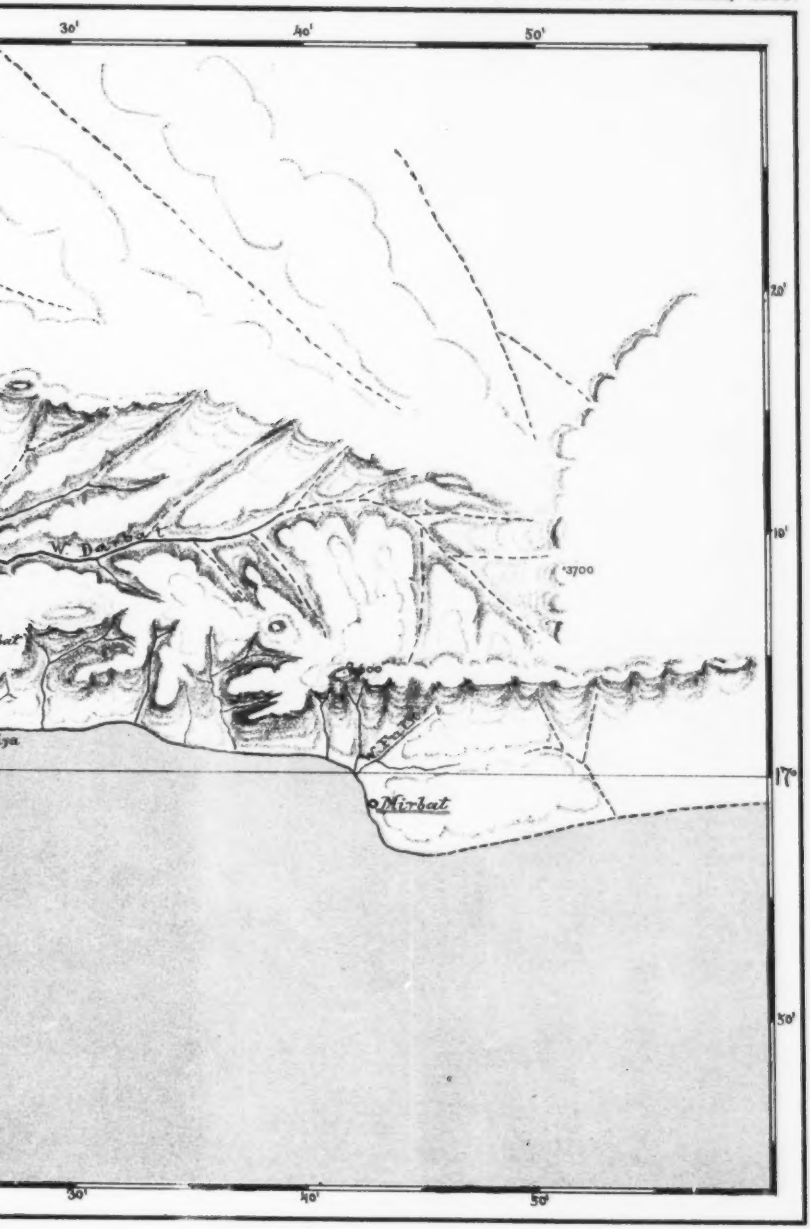
This is a very well-chosen set of photographs, illustrating the scenery of Japan.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.



B.V. Darbishire.

Published by the Royal Geographical Society.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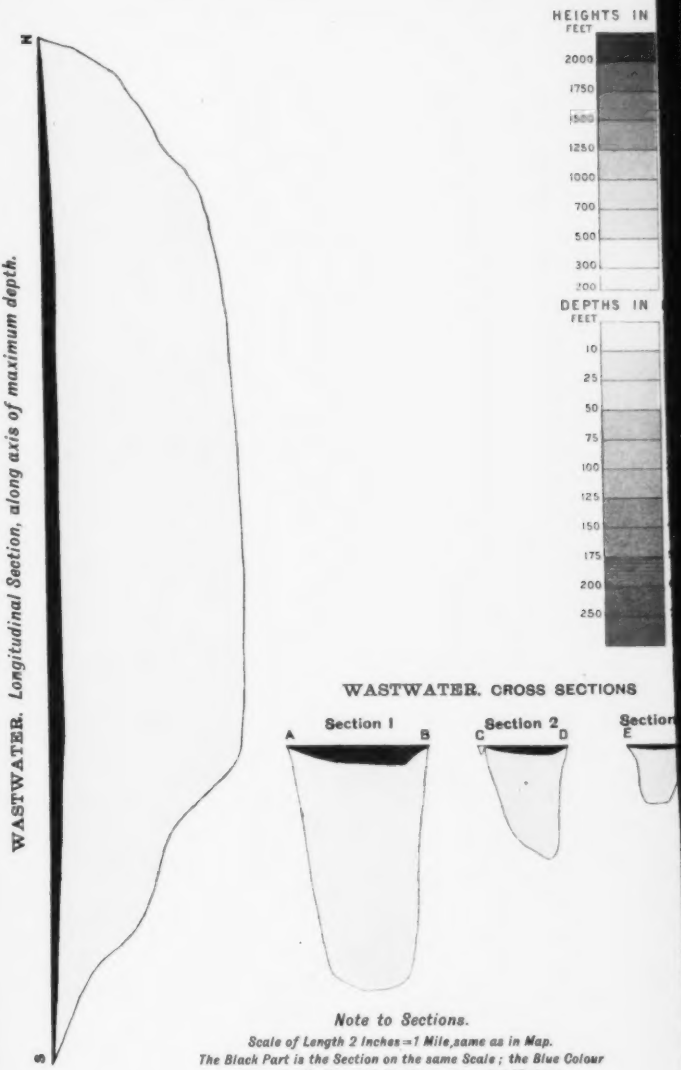


Note to Sections.

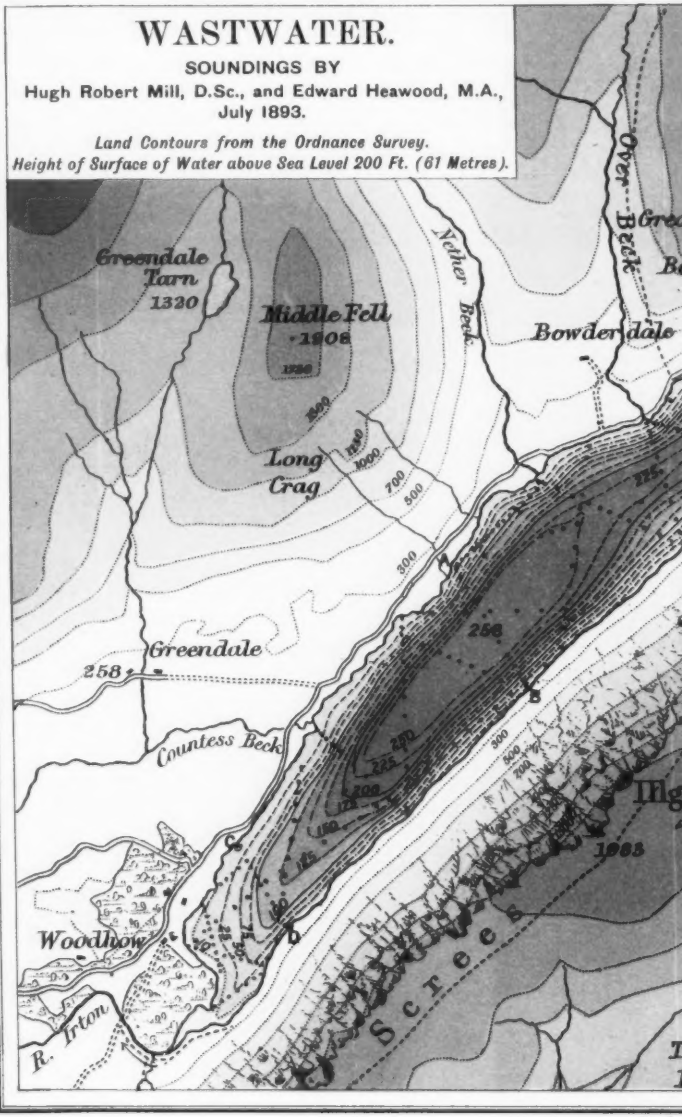
Scale of Length 2 Inches = 1 Mile, same as in Map.
The Black Part is the Section on the same Scale; the Blue Colour shows the Section with Depths exaggerated 15 times.

WASTWATER.

SOUNDINGS BY

Hugh Robert Mill, D.Sc., and Edward Heawood, M.A.,
July 1893.

Land Contours from the Ordnance Survey.
Height of Surface of Water above Sea Level 200 Ft. (61 Metres).



HTS IN FEET / METRES
609·6
533·4
457·2
381
304·8
213·4
152·4
91·4
61

THS IN FEET / METRES
3·05
7·6
15·2
22·9
30·5
38·1
45·7
53·3
61
76·2

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Section 3
E F

Scale
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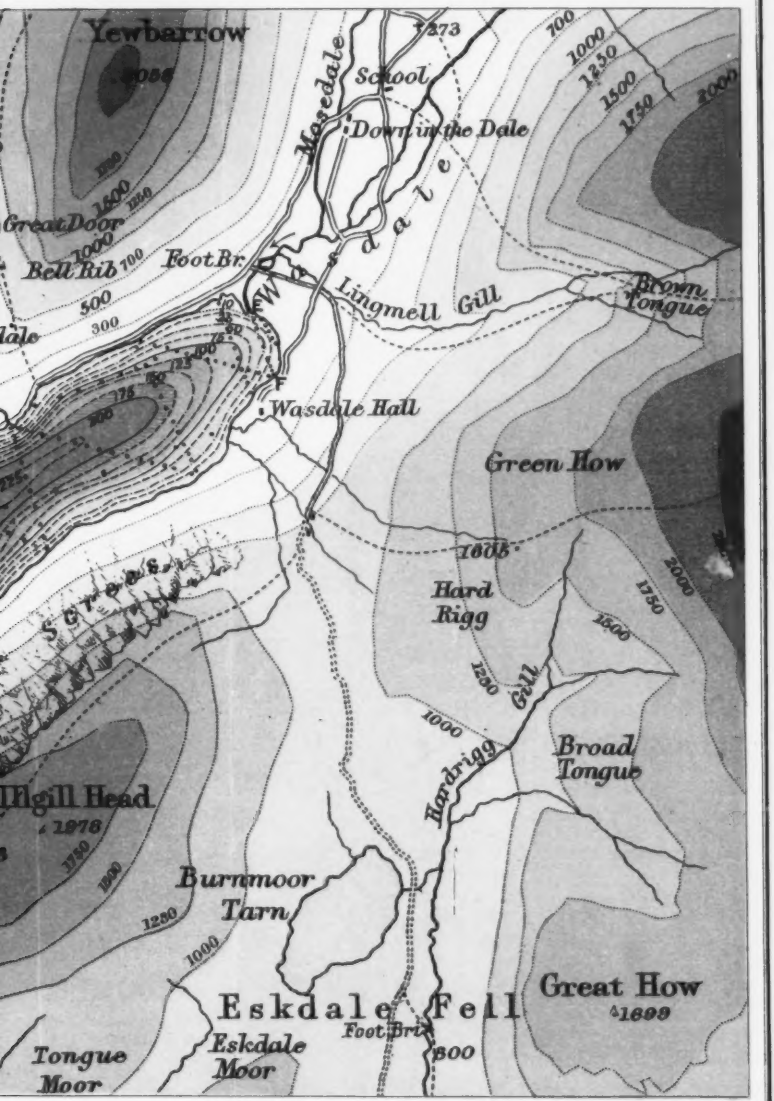


Scale 1 : 31,680

2 INCHES TO 1 MILE

1 CENTIMETRE — 0·31 KILOMETRE

1 Mile

1·61 Kilometres

Bartholomew Edin^r

the Royal Geographical Society.

Section, along axis of maximum depth.

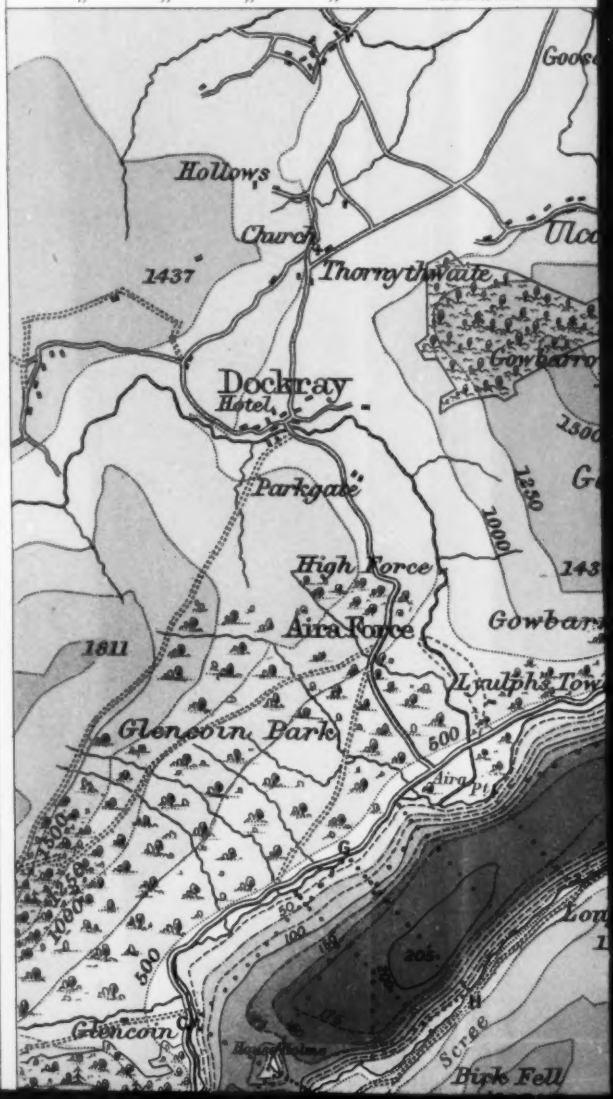
tion, along axis of maximum depth.

ULLSWATER AND HAWESV

SOUNDINGS BY

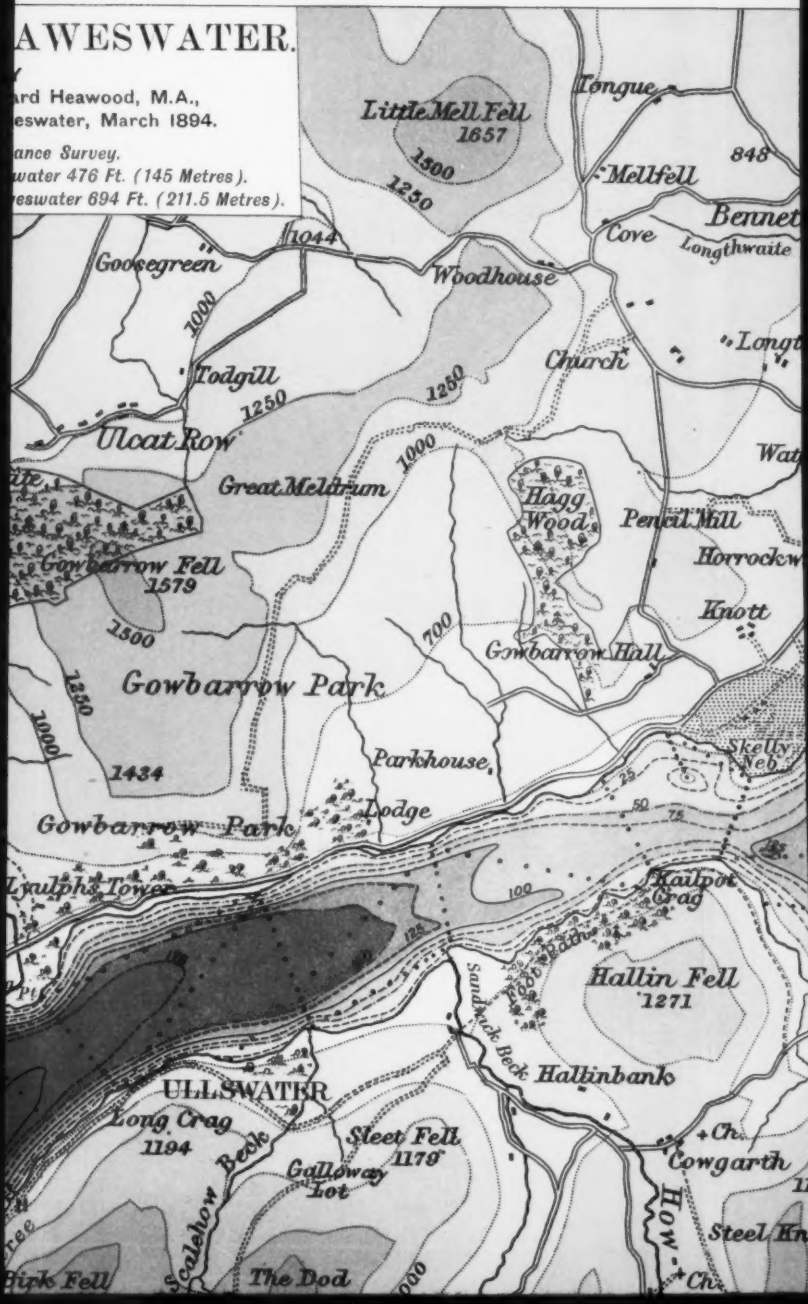
Hugh Robert Mill, D.Sc., and Edward Heawood,
Ullswater, June and July 1893; Haweswater, Marc

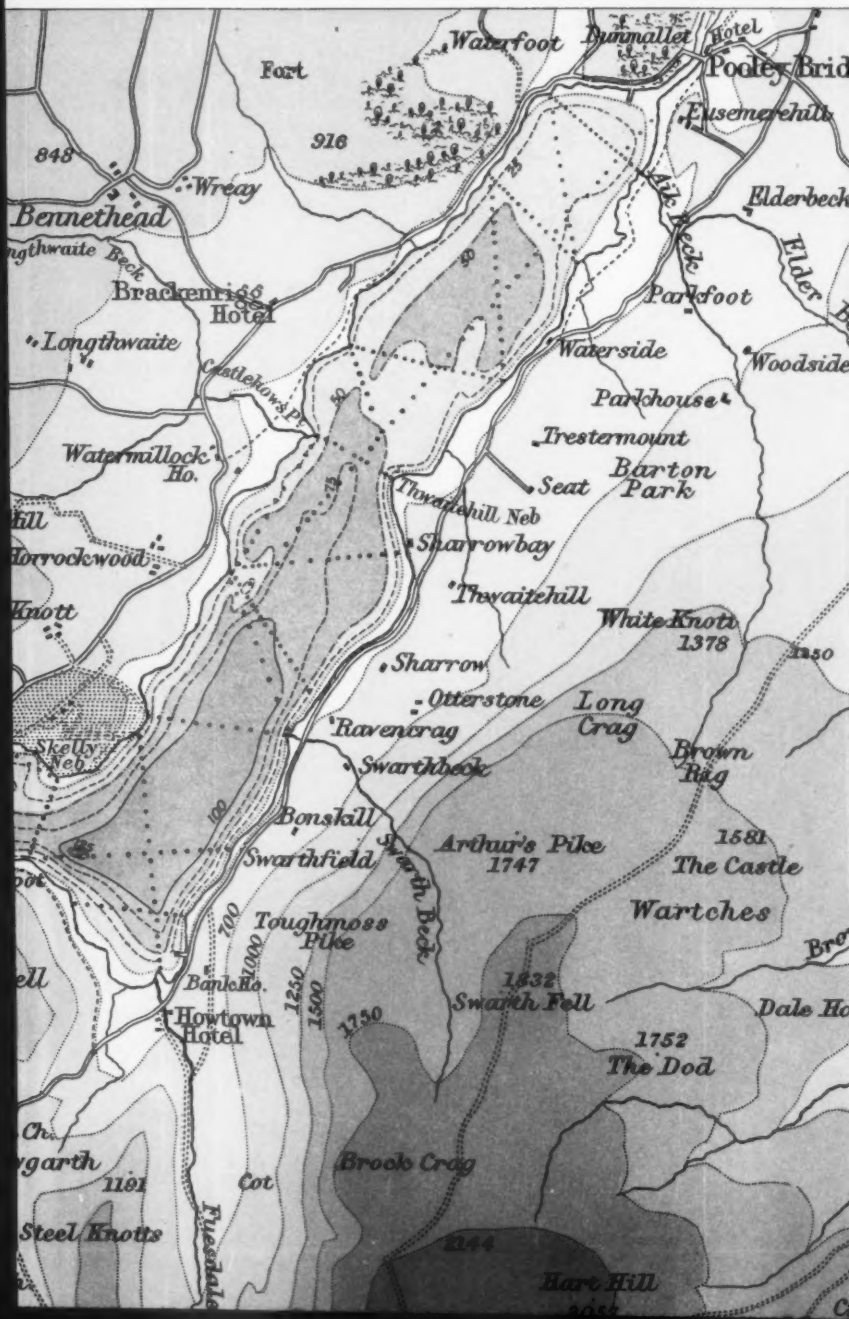
Land Contours from the Ordnance Survey.
Height of Surface of Water above Sea Level—Ullswater 476 Ft. (T
" " " " Haweswater 694 Ft.

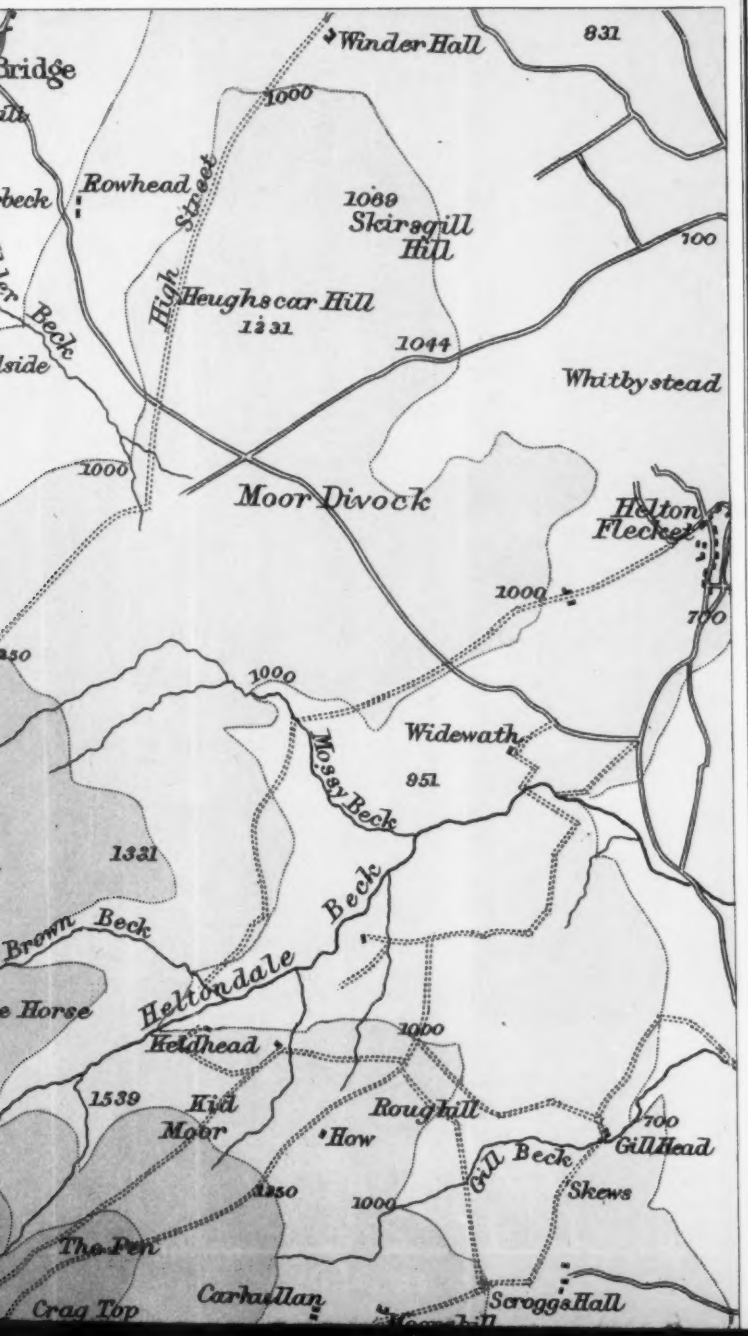


HEIGHTS IN FEET

FEET	METRES
2500	762
2000	609·6
1750	533·4
1500	457·2
1250	381
1000	304·8
700	213·4
500	152·4
300	91·4


AWESWATER.
ard Heawood, M.A.,
eswater, March 1894.
ance Survey.
water 476 Ft. (145 Metres).
eswater 694 Ft. (211.5 Metres).
Little Mell Fell
1657
Tongue
Mellfell
848
Bennet
Cove
Longthwaite
Goosegreen
Woodhouse
Todgill
Church
Ulcat Row
Great Melarum
Hagg Wood
Penal Mill
Horrockw
Gowbarrow Fell
1579
Knott
Gowbarrow Hall
Gowbarrow Park
Parkhouse
Lodge
Skelly Neb
Lyulphs Tower
Kailpot Crag
Hallin Fell
1271
Sandwick Beck
Hallinbank
ULLSWATER
Long Crag
1194
Steel Fell
1178
Galloway Tot
Cowgarth
Scalehow Beck
How
Steel Kn
Birk Fell
The Dod
1000
1250
1300
1044
700
1434


Waterfoot
Dunnallet
Hotel
Pooley Brid
Fort
916
848
Wreay
Bennethead
Elderbeck
Brackenrigg
Hotel
Longthwaite
Parkfoot
Waterside
Woodside
Parkhouse
Trestermount
Barton
Park
Seat
Watermillock
Ho.
Thwaitehill Neb
Sharrowbay
Horrockwood
Thwaitehill
White Knott
1378
Sharrow
Otterstone
Long
Crag
Ravencrag
Brown
Rig
Swarthbeck
Bonskill
Arthur's Pike
1747
1581
The Castle
Swarthfield
Wartches
Toughanoss
Pike
Howtown
Hotel
1632
Swarth Fell
Dale Ho
1752
The Dod
Brock Crag
1101
Steel Knotts
Hart Hill


Winder Hall
831
1000
Rowhead
1089
Skirsgill Hill
100
High Street
Heughscar Hill
1231
1044
Whitbystead
Moor Divock
Helton Flecket
1000
700
1000
Widewath
951
Mossy Beck
1331
Brown Beck
Beck
Heltondale
Keldhead
1000
1539
Kid Moor
How
Roughill
700
Gill Head
Gill Beck
Skews
1250
1000
The Pen
Carhullan
Scroggs Hall
Crag Top

ULLSWATER. Section 5 *Longitudinal Section*

HAWESWATER. *Longitudinal Section, alo*

Householm

Wallholm

ULLSWATER. CROSS SECTIONS

Section 1 A B

Section 2 C D

Section 3 E F G

HAWESWATER. CROSS SECTIONS

Section 1 A B

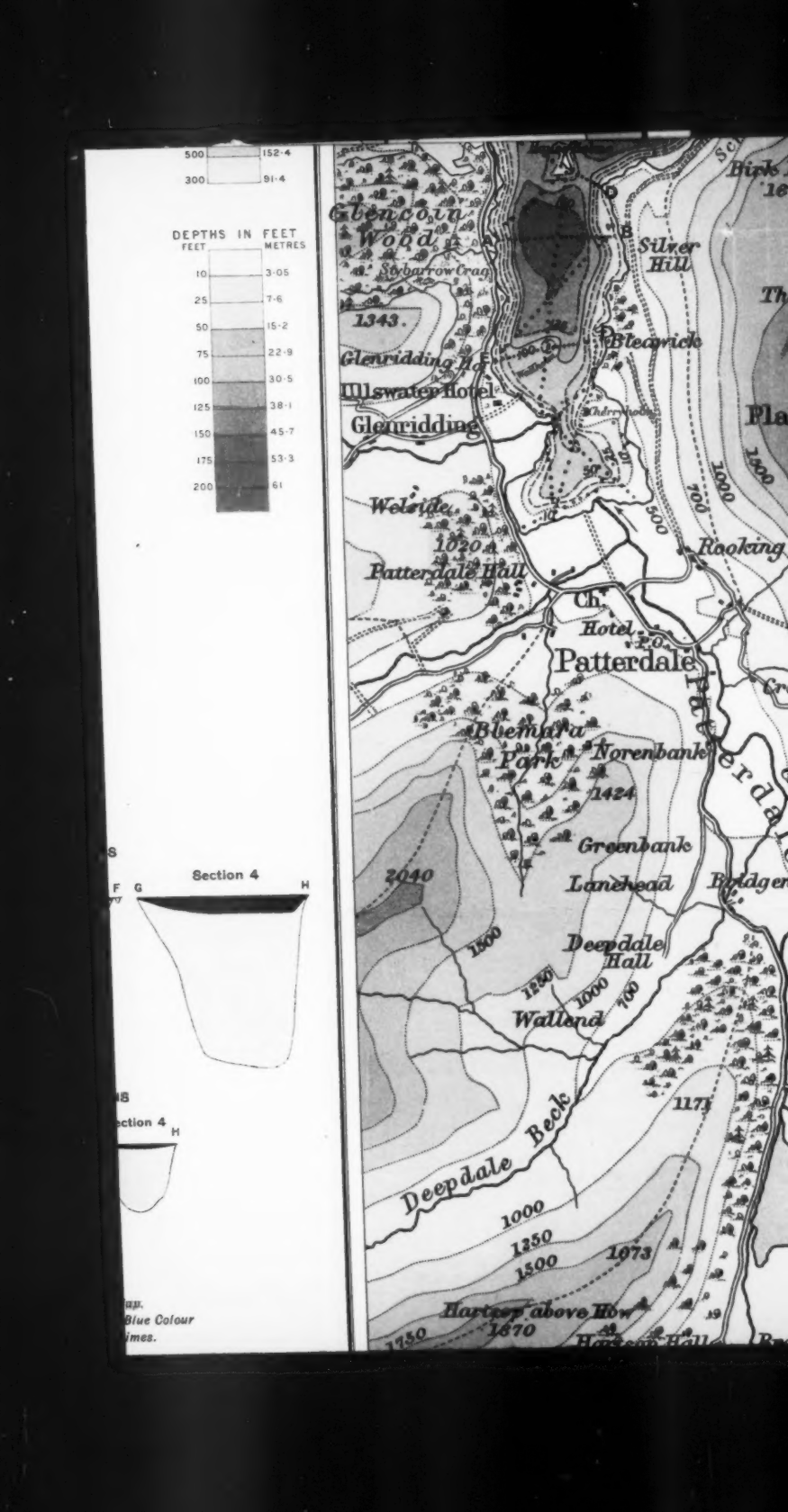
Section 2 C D

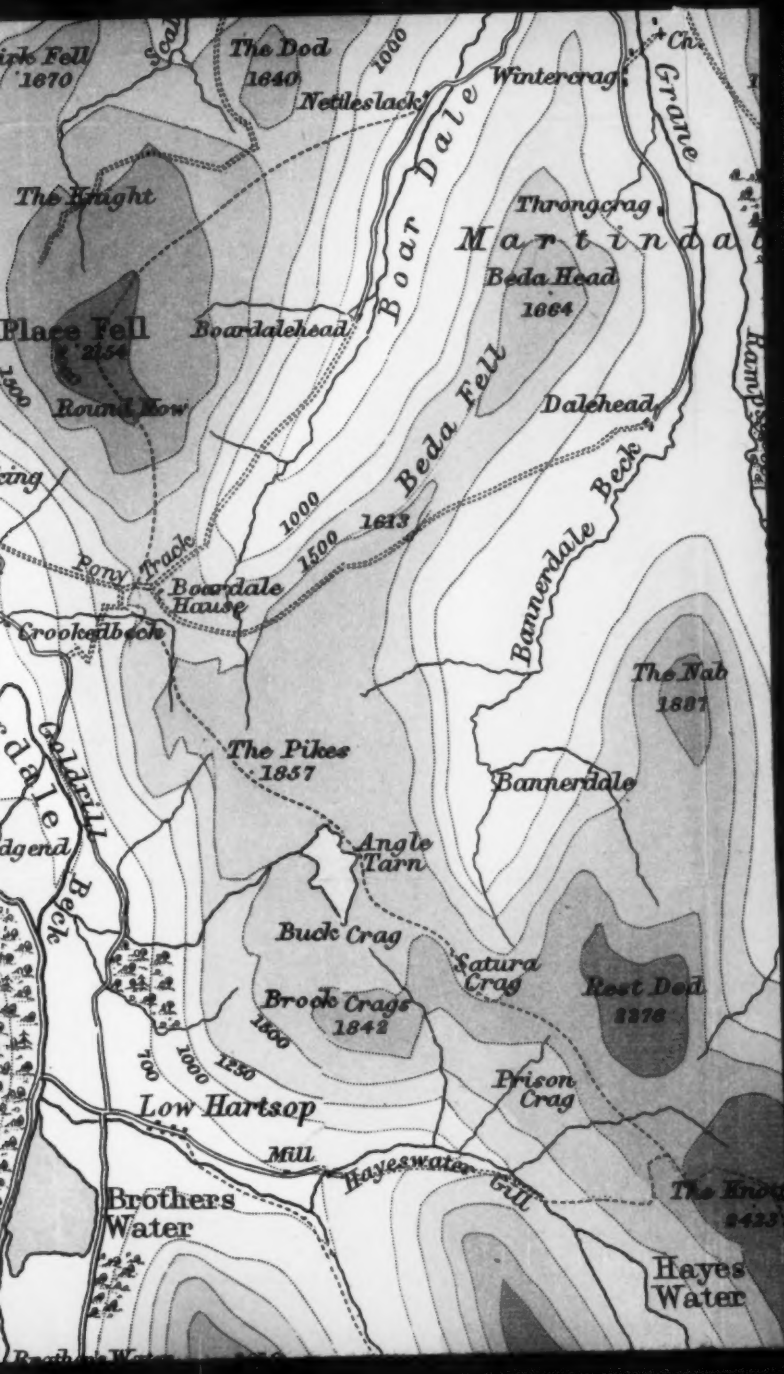
Section 3 E F

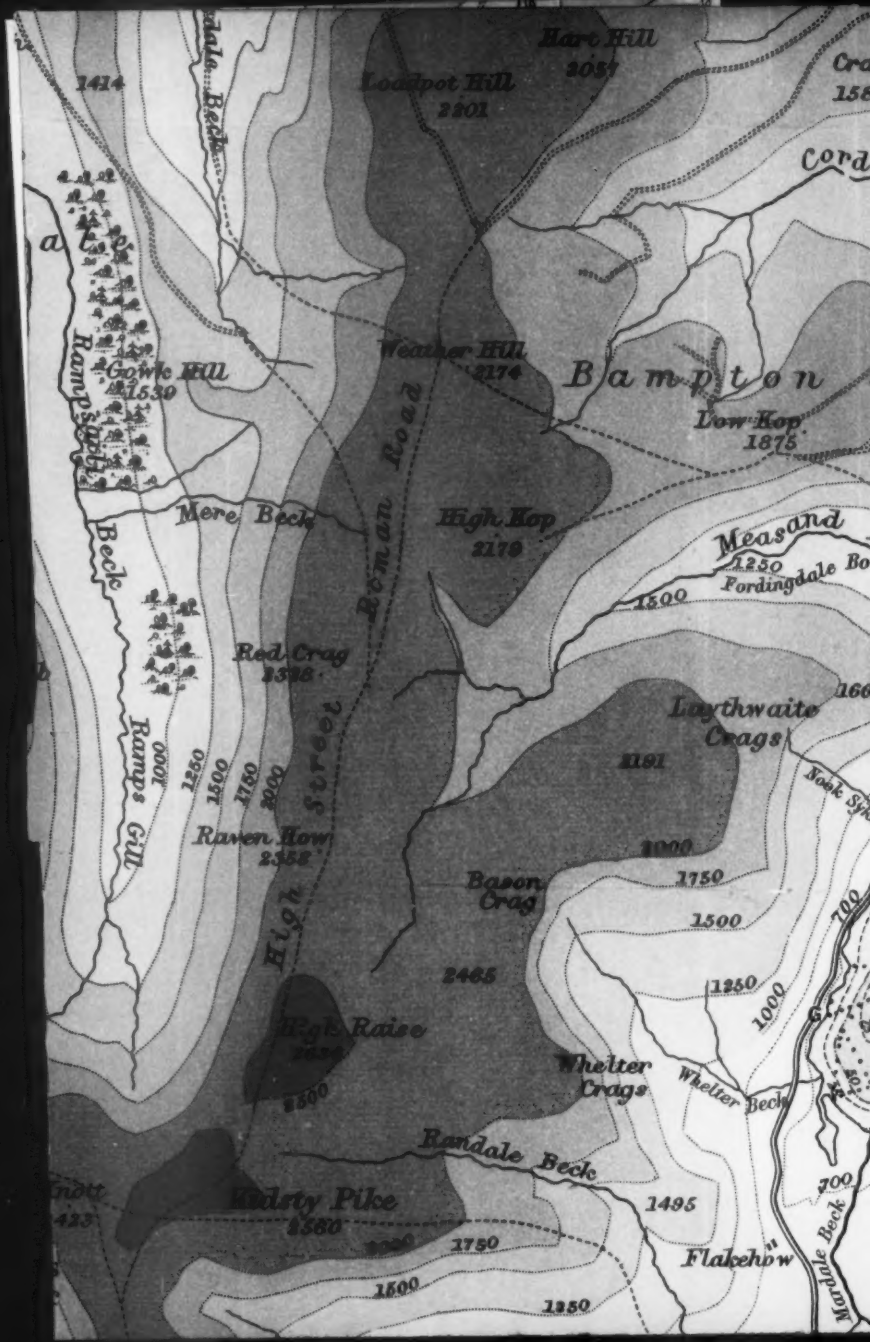
Section 4 G H

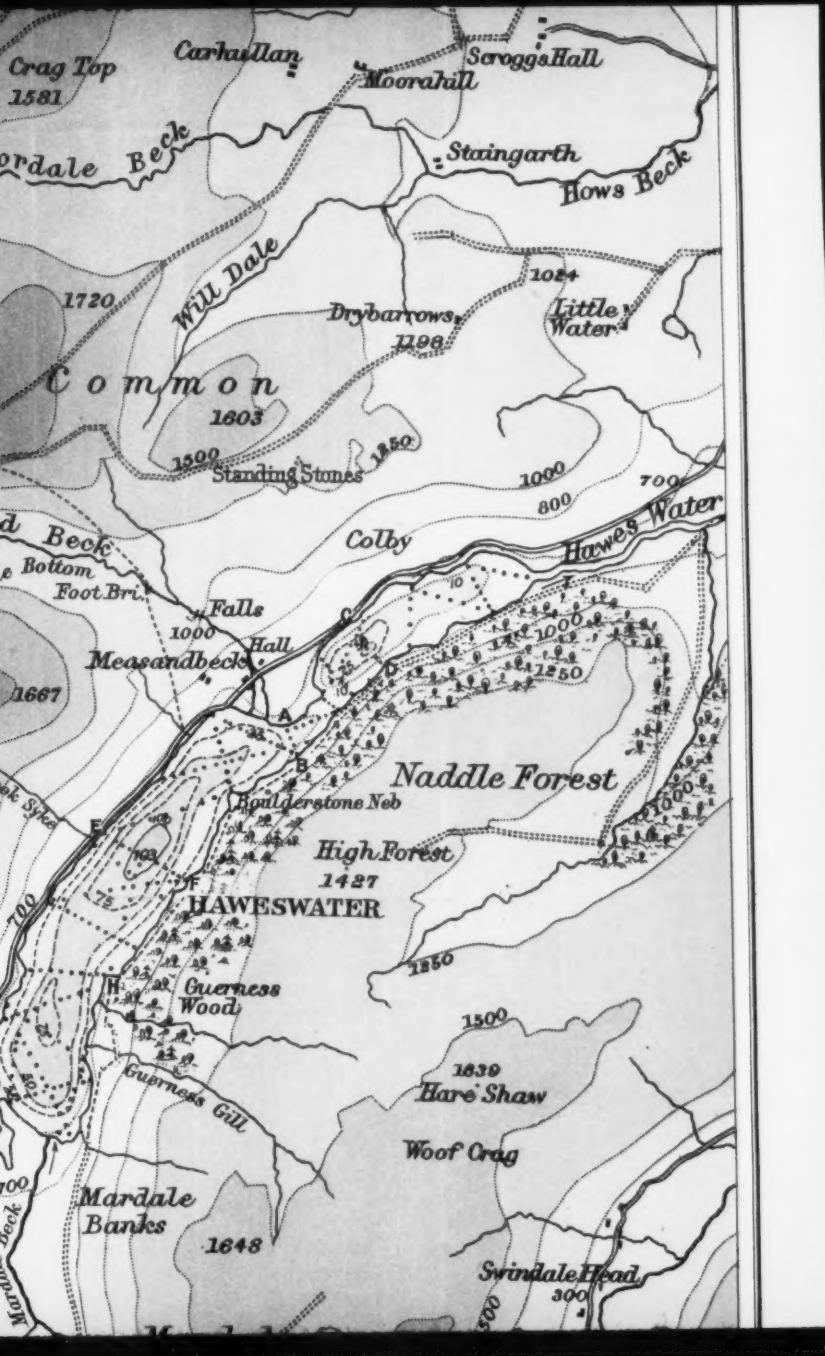
Note to Sections.

Scale of Length 2 Inches = 1 Mile, same as in Map.
The Black Part is the Section on the same Scale; the Blue Colour shows the Section with Depths exaggerated 15 times.


500 152·4
300 91·4
DEPTHS IN FEET
FEET METRES
10 3·05
25 7·6
50 15·2
75 22·9
100 30·5
125 38·1
150 45·7
175 53·3
200 61
Glencoyne Wood
Silver Hill
Sorbarrow Crag
1343.
Bleawick
Glenridding Hotel
Ullswater Hotel
Glenridding
Pla
Weiside
1020
Patterdale Hall
Rooking
Ch.
Hotel
P.O.
Patterdale
Ebenezer
Park
Norenbank
1424
Greenbank
2040
Lanehead
Bridger
Deepdale Hall
1500
1250
1000
700
Walland
1171
Deepdale Beck
1000
1350
1500
1973
Hartsop above How
1750
1670
Section 4
F G H
Section 4
H


The Dod
1640
Netleslack
Wintercrag
Boat Dale
Crane
The Knight
Throngcrag
Martinda
Beda Head
1664
Place Fell
2154
Boardalehead
Round How
Dalehead
Beda Fell
Bannerdale Beck
1000
1500
1613
Pony Track
Boardale House
Crookedbeck
The Nab
1887
The Pikes
1857
Bannerdale
Goldrill Beck
Angle Tarn
Buck Crag
Satura Crag
Rest Dod
2278
Brock Crags
1842
1800
1000
1250
Prison Crag
Low Hartsop
Mill
Hayeswater Gill
Brothers Water
Hayes Water

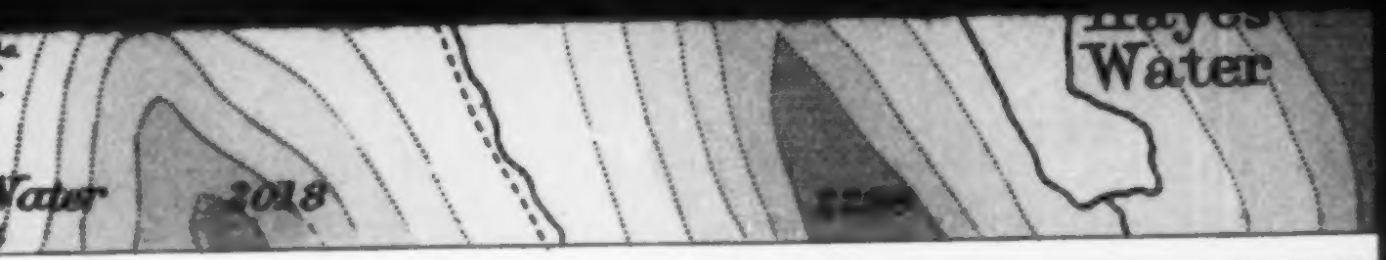

Hart Hill
2057
Loadpot Hill
2201
1414
Dale Beck
Cord
Gowk Hill
1530
Weather Hill
2174
Bampton
Low Kop
1875
Ramps Gill
Beck
Mere Beck
Roman Road
High Kop
2178
Measand
1250
Fordingdale Bo
1500
Red Crag
1528
Laythwaite
Crags
1191
Nook Syke
1000
1250
1500
1750
2000
Ramps Gill
Raven How
2352
High Street
Bason
Crag
1000
1750
1500
2465
1250
1000
High Raise
2500
Whelter
Crags
Whelter Beck
Randale Beck
Kidsty Pike
2560
1495
Flakehow
2750
1500
1250
Mardale Beck


Crag Top
1581
Carhullan
Scroggs Hall
Moorahall
Staingarth
Hows Beck
Will Dale
1720
1024
Little Water
Drybarrows
1198
Common
1803
1500
Standing Stones
1250
1000
800
700
Colby
Hawes Water
Bottom
Foot Bri
Falls
1000
Hall
Measandbeck
1667
1250
Naddle Forest
Boulderstone Neb
High Forest
1427
HAWESWATER
Guerness Wood
Guerness Gill
1639
Hare Shaw
Woof Crag
Mardale Banks
1648
Swindale Head
300

Note to Sections.

Scale of Length 2 Inches = 1 Mile, same as in Map.
The Black Part is the Section on the same Scale; the Blue Colour shows the Section with Depths exaggerated 15 times.

Map.
e Blue Colour
5 times.



0
0

Published

Scale 1 : 31,680

2 INCHES TO 1 MILE

1 CENTIMETRE — 0·31 KILOMETRE

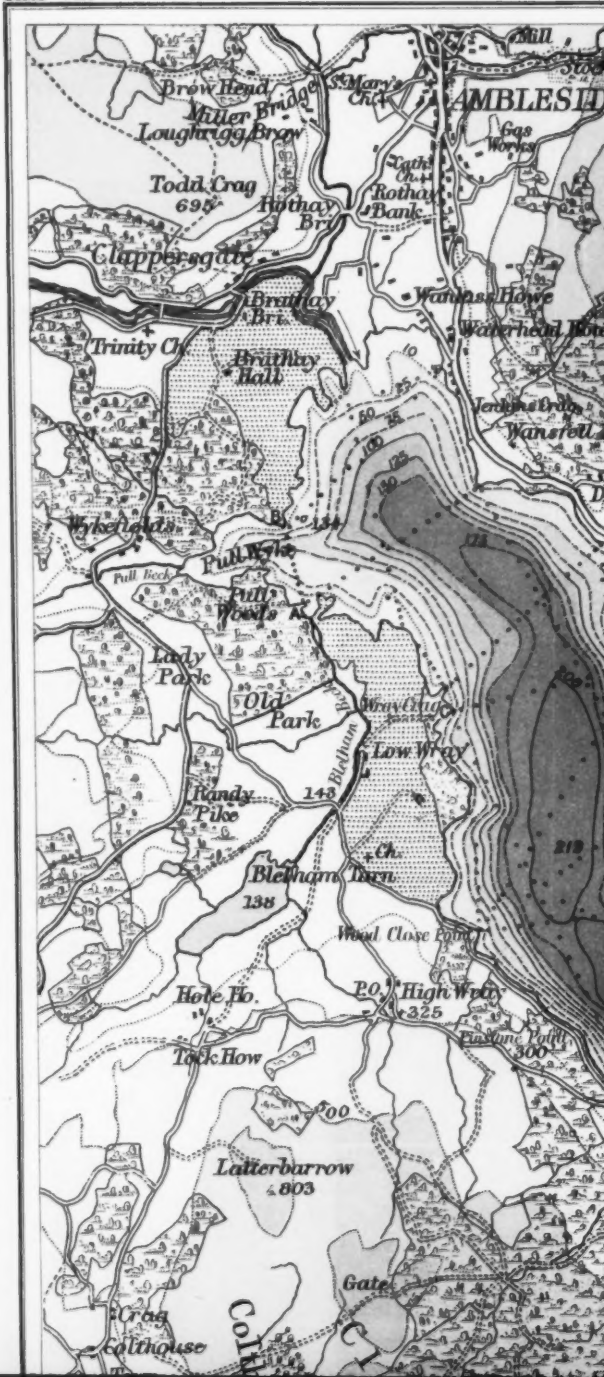
0 1 Mile

0 1 1·61 Kilometres

Published by the Royal Geographical Society.

Bartholomew Edin.

MAP VIII


Brow Head
Miller Bridge
Loughrigg Brow
Todd Crag
695
Hothay Brt.
Clappersgate
Brathay Brt.
Trinity Ch.
Brathay Hall
Wykeheads
Pull Beck
Pull Wyke
Pull Woods
Lady Park
Old Park
Randy Pike
Blelham Bridge
Low Wray
Blelham Tarn
Ch.
138
148
Wood Close Pond
Hole Ho.
P.O.
High Wray
325
Tock How
Latterbarrow
803
Gate
Crag
Colthouse
St. Mary's Ch.
Gas Works
Rothay Bank
Wanlass Howe
Waterhead
Jenkin's Crag
Wansfell
Mill

WINDERMERE.

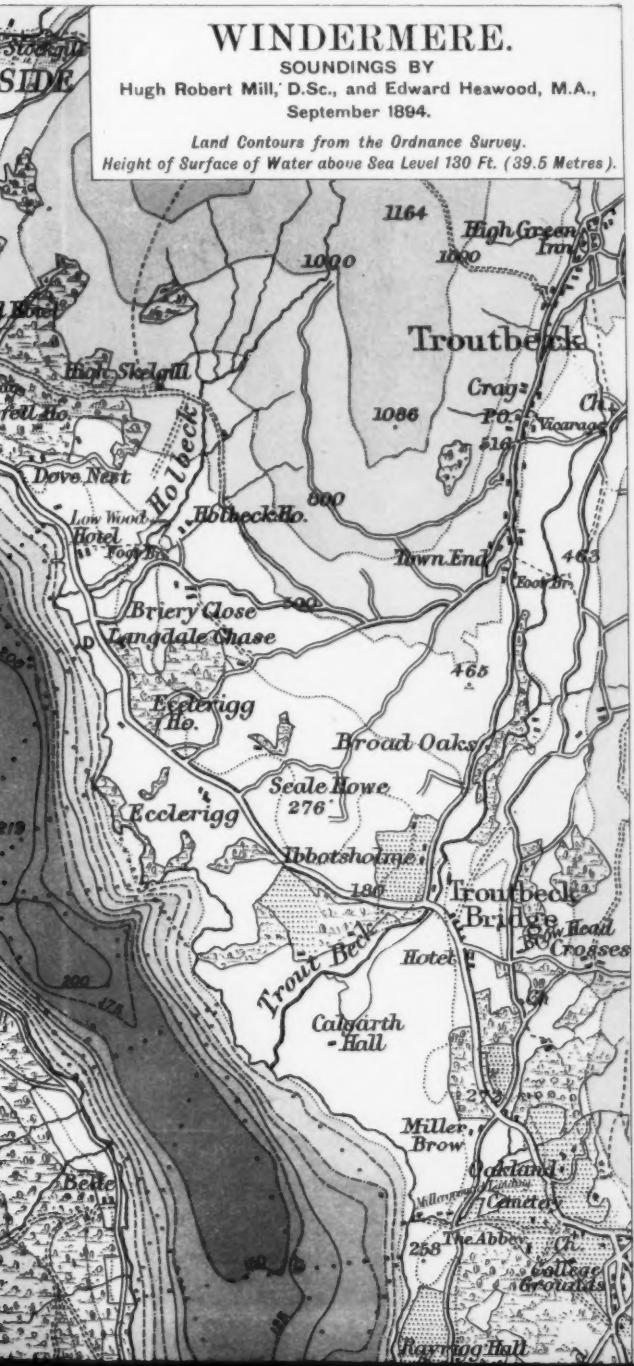
SOUNDINGS BY

Hugh Robert Mill, D.Sc., and Edward Heawood, M.A.,

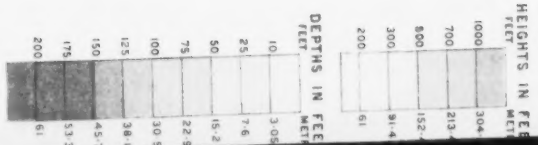
September 1894.

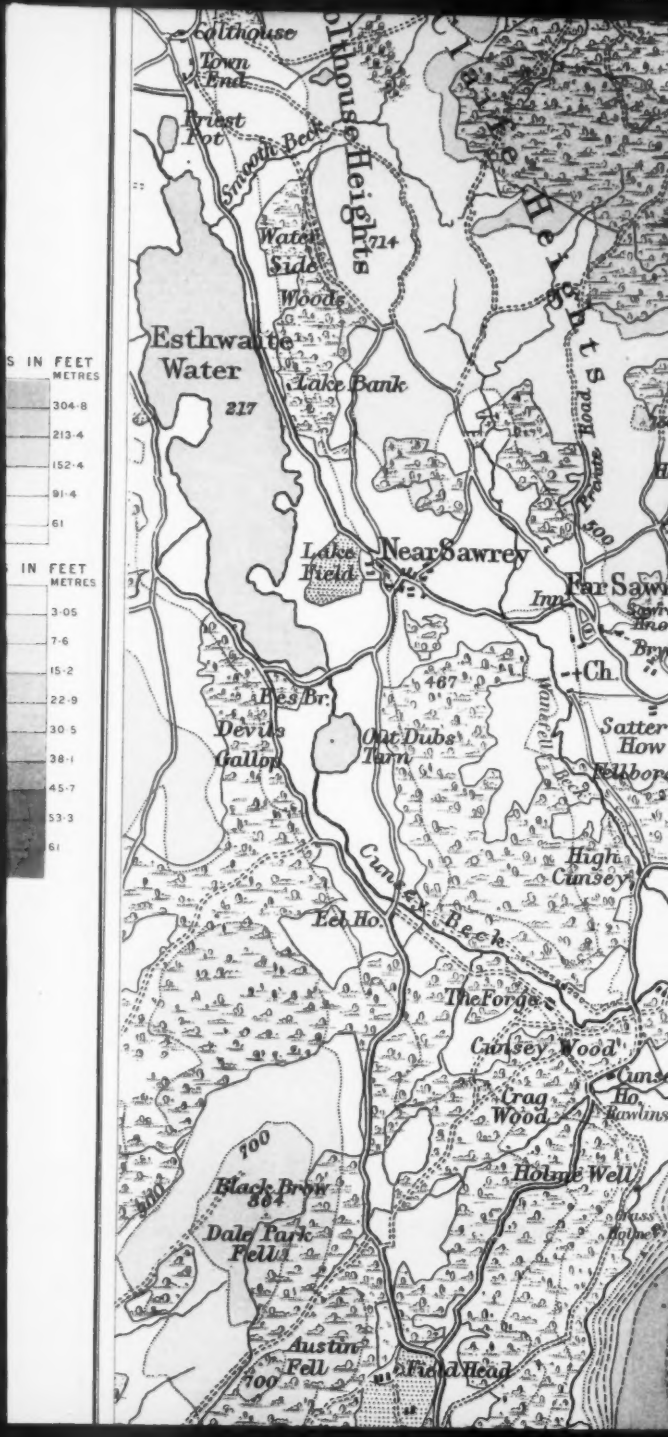
Land Contours from the Ordnance Survey.

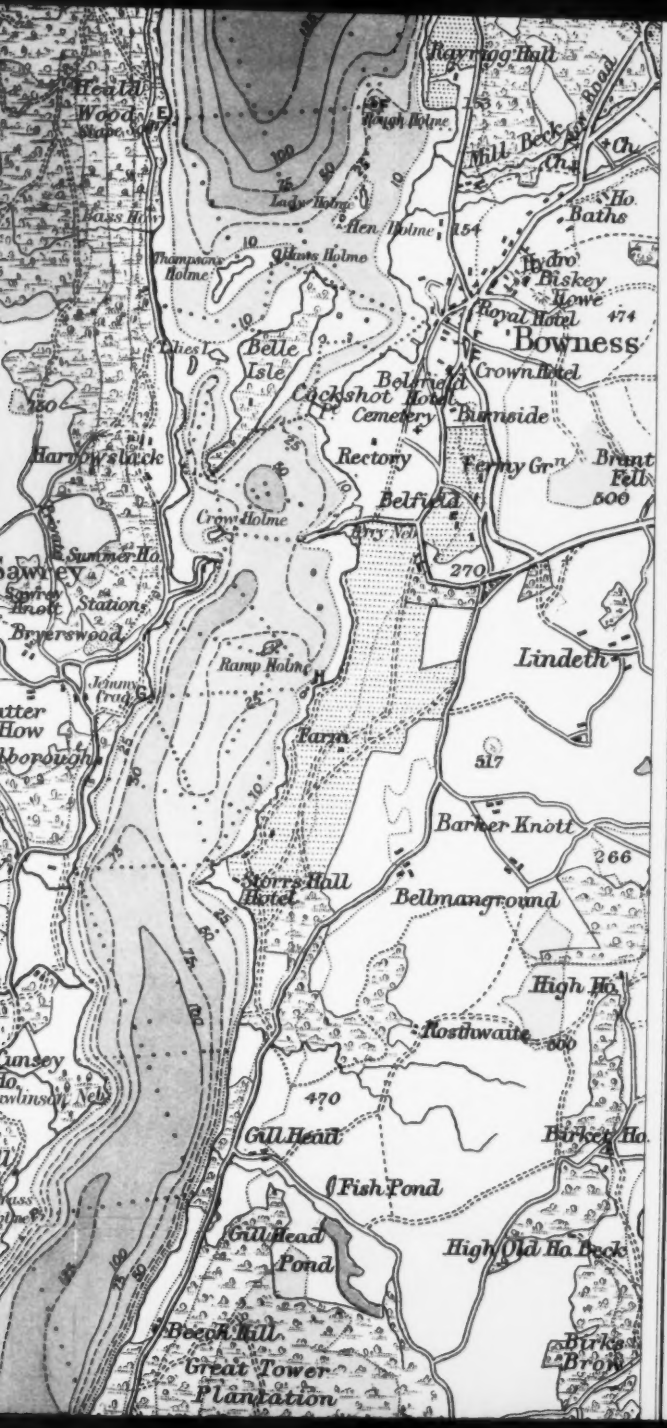
Height of Surface of Water above Sea Level 130 Ft. (39.5 Metres).



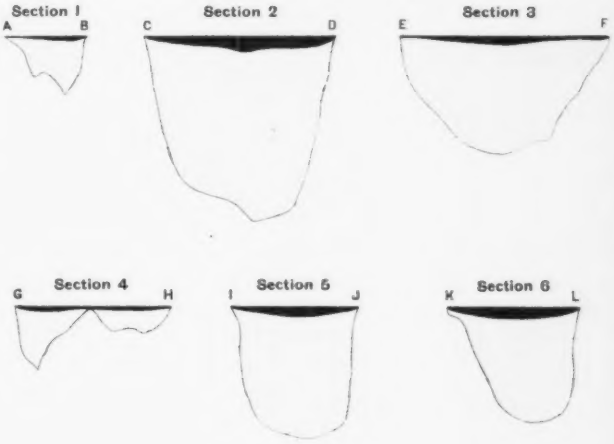
WINDERMERE. *Longitudinal Section, along axis of maximum depth.*




Calthouse
Town End
Priest Pot
Smaithe Beck
Calthouse Heights
Water Side
714
Woods
Esthwaite Water
217
Lake Bank
Lake Field
Near Sawrey
Far Sawrey
Inn
Ch.
Fees Br.
Devil's Gallop
467
Out Dubs Tarn
Satter How
Wander Hill
High Cunsey
Cunsey Beck
Eel Ho.
The Forge
Cunsey Wood
Cunsey Ho.
Crag Wood
Holme Well
700
Black Brow
804
Dale Park Fell
Austin Fell
700
Field Head
S IN FEET
METRES
304·8
213·4
152·4
91·4
61
IN FEET
METRES
3·05
7·6
15·2
22·9
30·5
38·1
45·7
53·3
61

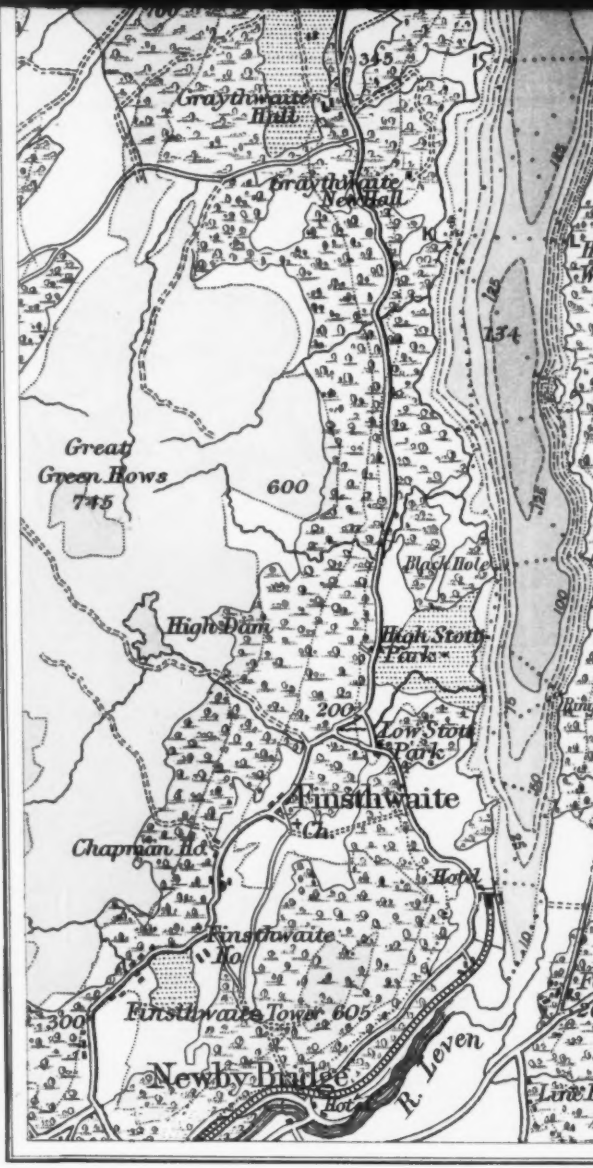

Raygill Hall
Heath Wood
Rough Holme
Mill Beck
Ch.
Ho.
Baths
Lady Holme
Hen Holme
Bass Ho.
Thompsons Holme
Gilnes Holme
Hydro
Biskey Howe
Royal Hotel
Bowness
Belle Isle
Crown Hotel
Belfield
Cockshot Hotel
Cemetery
Burnside
Harrowslack
Rectory
Ferry Gn.
Brant Fell
Belfield
Crow Holme
Ferry Net
Summer Ho.
Stations
Bryerswood
Ramp Holme
Lindeth
Farm
Barker Knott
Storrs Hall Hotel
Bellmanground
High Ho.
Rosthwaite
Gill Head
Fish Pond
Gill Head Pond
High Old Ha Beck
Beech Hill
Great Tower Plantation
Burke's Brow

WINDERMERE. CROSS SECTIONS



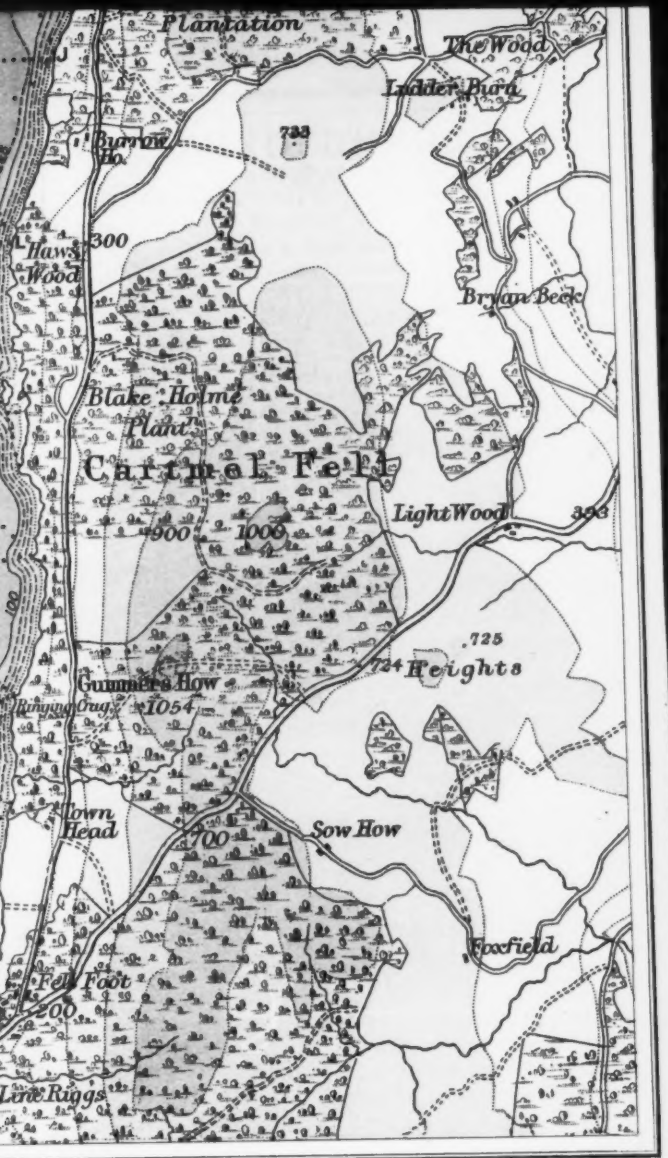
Note to Sections.

Scale of Length 2 Inches = 1 Mile, same as in Map.
The Black Part is the Section on the same Scale; the Blue Colour shows the Section with Depths exaggerated 15 times.



Scale
2 INCHES
1 CENTIMETRE

Published by the Roy



Scale 1 : 31,680

INCHES TO 1 MILE

METRE — 0·31 KILOMETRE

1 Mile

1·61 Kilometres

Bartholomew Edin.

he Royal Geographical Society.